

2. *Revision of the Fauna of the Bokkeveld Beds.*—By F. R.

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(With Plates IV–XI.)

INTRODUCTION.

SINCE the publication of the descriptions of the Trilobita, Brachiopoda, and Mollusca of the Bokkeveld Beds by Mr. P. Lake * and the author † in the Annals of the South African Museum about twenty years ago, a considerable amount of fresh material has been collected. Some of it was described by the author ‡ in a supplementary paper in the Annals in 1908, and in another communication to the Geological Magazine in 1906, § while in the latter year Professor Schwarz || dealt with some specimens in the Albany Museum and described several new species. The present author reviewed the whole fauna and its relations in 1907, ¶ and gave a list of references to papers concerning it up to that date. The great progress which has been made during recent years in our knowledge of the Devonian faunas of the South American continent has led to their closer comparison with the fossils of the Bokkeveld Beds, and Thomas,** Knod, †† Clarke, ‡‡ and

* Lake, "The Trilobites of the Bokkeveld Beds," Ann. S. Afr. Mus., vol. iv, pt. 4, No. 9, 1904, pp. 201–220, pls. xxiv–xxviii.

† Reed, "Brachiopoda from the Bokkeveld Beds," *ibid.*, vol. iv, pt. 3, No. 7, 1903, pp. 165–200, pls. xx–xxiii; "Mollusca from the Bokkeveld Beds," *ibid.*, vol. iv, pt. 6, No. 11, 1904, pp. 239–272, pls. xxx–xxxii.

‡ Reed, "New Fossils from the Bokkeveld Beds," *ibid.*, vol. iv, pt. 8, No. 14, pp. 381–406, pls. xlvii, xlviii.

§ Reed, "New Fossils from the Bokkeveld Beds," Geol. Mag., Dec. v, vol. iii, 1906, pp. 301–310, pls. xvi, xvii.

|| Schwarz, "South African Palaeozoic Fossils," Rec. Alb. Mus., vol. i, pt. 6, 1906, pp. 347–404, pls. vi–x; Reed, Geol. Mag., Dec. v, vol. iv, 1907, pp. 34–36.

¶ Reed, "Fauna of the Bokkeveld Beds," Geol. Mag., Dec. v, vol. iv, pp. 166–171, 222–232.

** Thomas, Zeitschr. deut. geol. Gesell., vol. lvii, 1905, pp. 233–290, pls. xi–xiv.

†† Knod, Neues Jahrb. f. Miner. Geol., Beil. Bd. xxv, 1908, pp. 493–600, pls. xxi–xxxi.

‡‡ Clarke, "Fosseis devonianos do Parana," Mon. Serv. Geol. Miner. Brasil, vol. i, 1913, pp. 1–353, pls. i–xxvii.

Kozłowski * have paid special attention to this matter, while further material from the Falkland Isles has been studied by Newton † and Clarke. It seemed, therefore, to the author that a revision of the South African material was desirable as well as an examination of the large number of new specimens which had been added to various museums. Accordingly, during a visit in 1924 of six months to South Africa, a detailed study was made of the collections in the museums at Cape Town, Pretoria, Bloemfontein, Grahamstown, Kimberley, and Stellenbosch, in each of which a rich series of fossils is preserved, while the smaller collections in the Port Elizabeth, Maritzburg, Durban, and Buluwayo Museums were also examined. To all those who afforded me the facilities for working at these collections and gave me much assistance in the task, my hearty thanks are due.

The author himself was also able to study to some extent the beds in the field and to collect specimens in the districts of Ceres and De Doorns through the kindness of the farmers and others in those parts.

The old collections in the British Museum which Salter and Sharpe described, together with the recent additions, have been re-examined, and some new material in the Sedgwick Museum, Cambridge, from the Bokkeveld Beds has also been studied.

The comparison of many of the fossils with those from corresponding beds in South America has been rendered easier by the presence of a representative series from the Falkland Islands in the Albany Museum, Grahamstown, and of specimens from Brazil in Dr. A. L. du Toit's collection in Cape Town.

In those cases in which the synonymy of the species has been previously given by Mr. Lake or the author in their descriptions of the fossils in the *Annals of the South African Museum*, 1903-08, and is still accepted as correct, it is not repeated, but where modifications of the views there expressed have been made, a new list of synonyms and references is given.

We cannot avoid expressing the opinion that many of the species of South African and South American Devonian fossils rest on somewhat insecure foundations, and in some cases it would have been better if no new specific names had been used. For there is often much doubt as to the true characters of the specimens, the types being in a poor or unsatisfactory state of preservation, and even the critical generic characters are sometimes not shown.

* Kozłowski, "Fossiles devoniennes de Brésil," *Ann. de Paléont.*, vol. viii, 1913, pp. 1-19, pls. i-iii; "Foss. Devon. Bolivie," *ibid.*, vol. xii, 1923, pp. 1-112, pls. i-x.

† Newton, *Proc. Roy. Phys. Soc. Edinburgh*, vol. xvi, 1906, pp. 248-257, pl. x.

Difficulties also arise from want of agreement as to which examples should be regarded as typical, so that the views of authors frequently differ widely as to the limits of the species or the identity of African and American forms. Such obstacles are met with especially in the case of the older established Bokkeveld species, and render a comparison of the fossils less precise than could be wished. But, on the whole, the close resemblance of the Devonian faunas from opposite sides of the South Atlantic is a most noteworthy and conspicuous feature, and the detailed analysis of the Bokkeveld fauna brings out this similarity to a striking extent.

From the fact that the author was fortunate enough to discover several new species and even genera which had not been previously recorded from the Bokkeveld Beds, in the course of his brief visits to certain exposures near Ceres and De Doorns, it is extremely probable that many more additions will have to be made in the future to the fauna of these beds when collecting is more thoroughly and extensively done.

Moreover, when Dr. W. K. Spencer has finished his investigation of the Asteroidea, there will be several new forms to be added to the list of fossils, though as yet he is unable to furnish me even with generic names. The present list of species cannot, therefore, be considered final or exhaustive, but so far as existing material allows it is as complete as possible.

ACTINOZOA.

Zaphrentis ? zebra, Schwarz.

1906. *Zaphrentis zebra*, Schwarz (pars), Rec. Albany Mus., vol. i, No. 6, p. 360, pl. vii, fig. 12 (1586 Alb. Mus.).

The specimen from the Cockscomb Mountains which Schwarz figured as *Zaphrentis zebra* is in the condition of a distorted internal cast, and therefore not in a satisfactory state of preservation for determination, and even the genus is doubtful. Schwarz's definition is therefore unavoidably incomplete, and it does not apply strictly to the second specimen (1587 Alb. Mus.) which he mentions (but does not figure) under the same name.

Corals are extremely rare in the Devonian beds of the Southern type, and of simple forms Kozłowski* is the only author who

* Kozłowski, "Faune Dev. Bolivie," Ann. Paléont., vol. xii, 1923, p. 97, pl. x, figs. 5-7.

describes a species which comes from Bolivia and is referred to *Cyathophyllum*.

Zaphrentis ? sp.

1906. *Zaphrentis zebra* Schwarz (pars), Rec. Albany Mus., vol. i. pt. 6, p. 360 (*non* pl. vii, fig. 12) (1587 Alb. Mus.).

The second and smaller specimen (1587 Alb. Mus.) of a single coral which Schwarz did not figure was found also in the Cockscomb Mountains. It has much fewer septa than the figured specimen (1586), and the short secondary septa are more regular. The corallum is also more slender, tapering more slowly to the base. As in the other case it is preserved only as a cast, and its generic reference is doubtful.

Striatopora ? sp.

On the slab of rock (H. 67 Stell. Mus.) from Hottentot's Kloof, containing *Lingula scalprum* Clarke, there are a few scattered broken branches of a small ramose coral 10 mm. or more long, apparently rather like the Silurian *Striatopora flexuosa* Hall. The branches are cylindrical and very slender, measuring only about 1 mm. in diameter, and bifurcate occasionally, diverging at about 90°. Traces of the few corallites composing them are visible, and only 3-4 appear to be present on the circumference, the apertures being large, hexagonal or polygonal, with deep vestibules radially striated. None are sufficiently perfect for a detailed description, and the genus is somewhat uncertain.

CYSTIDEA.

Placocystis africanus sp. nov.

(Pl. IV, fig. 1.)

Theca subovoid, truncated at upper end, excavated at lower end for attachment of stem, much compressed dorso-ventrally; lateral edges gently arched, subparallel. Dorsal side flattened, composed of 5 transverse series of plates of unequal size more or less regularly arranged in 4 vertical rows; the lowest series comprises a pair of long subrectangular median basals and a pair of narrower subtriangular lateral basals forming the lower angles of the theca; the second series consists of 4 shorter transversely subquadrate plates; the third series of 4 larger subrectangular plates of which the laterals are oblong and larger than the median ones; the fourth series of 4

or more rather smaller plates of which the inner pair seem to be suboblong (but this part of the theca is poorly preserved), the outer plates are subquadrate and apparently have a small subtriangular plate above them; the fifth series consists of several small narrow transverse plates, forming an upper marginal band to the theca which bears a short cylindrical spine or brachiole at each corner (?). Surface of plates granulated and ornamented with small tubercles. Ventral face gently convex (imperfectly known); the lower plates ornamented with fine, horizontal, closely-set, parallel, laminated lines. Stem slender, cylindrical, about one and a half times the length of theca, composed of a double longitudinal series of about 20 thick subquadrate ossicles with granulated surface.

Dimensions :—

Length of theca	.	.	.	13.0 mm.
Width	„	.	.	9.5 „

Remarks.—There is only one specimen of this interesting fossil known to me from the Bokkeveld Beds, and it was collected by me at the roadside cutting near Buffelskraal, between De Doorns and Tunnel Siding. The dorsal surface (except near the top) is well preserved and shows many of the plates; the ventral surface is only exposed near the base where the dorsal surface is broken; the stem is attached, but the spine-like brachiole on the right-hand side is slightly displaced and only shows as an impression. The left-hand edge of the specimen is slightly imperfect, and the articulation of the stem with the theca is somewhat broken. The arrangement of the plates is more regular than in *Anomalocystis disparilis* Hall * from the upper part of the Oriskany Formation, and seems more like *Placocystis forbesianus* De Kon. Bather † suggests that *A. disparilis* should be referred to *Placocystis* De Koninck, and that *A. cornutus* Hall ‡ from the Helderbergian should be placed in the genus *Ateleocystis* Billings. But Schuchert (*op. cit.*) and Kirk § do not agree with this view, and retain the two American species in *Anomalocystis*. The latter describes the spine-like brachioles at the upper angles of the theca in *A. disparilis* as in *Placocystis* and in our Bokkeveld species, and the stem structure is very similar.

* Schuchert, "Siluric and Devonian Cystidea," Smithsonian Miscell. Coll., vol. xvii, pt. 2, 1904, p. 207, figs. 22*a*, *b*, *id.* Maryland Geol. Surv., Lower Devonian, 1913, p. 228, pl. xxxii, figs. 1-3.

† Bather in Lankester's Treatise on Zoology, pt. 3, 1900, p. 51, text-fig. 13.

‡ Schuchert, *op. cit.*, 1904, p. 206, figs. 21*a*, *b*, pl. xl, figs. 4, 5.

§ Kirk, Proc. Nat. Mus. U.S.A., vol. xli, No. 1846, 1911, pp. 22-26, pl. 3, figs. 9-11.

BLASTOIDEA.

Codaster aff. *pyramidatus*, Shumard.

(Pl. IV, fig. 2.)

Only one fragment of a blastoid has so far been discovered in the Bokkeveld Beds, and it was collected by me from the road-cutting about six miles north of De Doorns in the Hex River Valley, on the way to Tunnel, from the same bed as the cystidean described above. The fragment consists of one of the radial plates of a species of *Codaster*; it is of an elongated hexagonal or pentagonal shape, gently convex from side to side, the long, straight, lateral edges being parallel, and the lower edges slightly concave and meeting at an obtuse angle; the upper end is not perfect, but shows two sets of 16-20 short parallel slits, representing the hydrospires, on each side of a short, broad, sub-triangular, median notch or groove. Fine concentric lines parallel to the lateral edges can also be detected in one place. The length of this plate is 19 mm. and its width 13 mm.

The only recorded example of a blastoid from the Devonian of the southern hemisphere is that figured by Knod* from Bolivia as *Codaster* aff. *pyramidatus* Shumard,† and it much resembles our specimen, differing chiefly in having a less symmetrical outline and in the hydrospires occupying a larger lozenge-shaped area at the upper end as well as being more numerous and decreasing more rapidly in length on each side.

ASTEROIDEA.‡

Echinasterella? sp.

There are some specimens (3881, 3375 S.A. Mus.) in the South African Museum which may be attributed to this genus and appear to

* Knod, Neues Jahrb. f. Miner. Geol., Beil. Bd. xxv, 1908, p. 565, t. xxviii, figs. 9, 9a.

† Shumard, Trans. St. Louis Acad. Sc., 1858, vol. i, pt. 2, pp. 238, 247, pl. ix, figs. 1a-c; Etheridge and Carpenter, Catal. Blastoides Brit. Mus., 1886, p. 266, pl. xii, figs. 1-3.

‡ Dr. W. K. Spencer has been engaged for some years on a study of the Palaeozoic Asteroidea, and has under examination a considerable series of specimens of this group from the Bokkeveld Beds. But his results have not so far been published, and he informs me that at least another year's work is required before he can be certain of the genera.

resemble in many respects *Ech. Darwini* Clarke * from Brazil. Kozłowski † records the genus also from the Devonian of Bolivia.

Aspidosoma? sp.

A fragmentary asterid (2610 Alb. Mus.) in the Albany Museum may be compared with *Aspidosoma pontis* Clarke, ‡ from Brazil, but the specimen is insufficient to decide its reference. Kozłowski § refers a Bolivian fossil to this genus with a query.

CRINOIDEA.

Ophiocrinus Stangeri, Salter.

1856. *Ophiocrinus Stangeri*, Salter, Trans. Geol. Soc., ser. 2, vol. vii, p. 223, pl. xxv, fig. 20.

The type of this species is in the British Museum. The exact locality is not known.

There is a good specimen of it (2608 Alb. Mus.) in the Albany Museum from Gydo Pass and one in the Pretoria Museum (169 Pret. Mus. type 2) from Montagu. It may be here mentioned that Salter's genus *Ophiocrinus* (1852) is not identical with Angelin's genus (1878) bearing the same name, as Wachsmuth and Springer || pointed out. Bather ¶ has given a precise synopsis of the characters of the genus which he places in the *Rhodocrinidae*.

Crinoid stems.

1856. Crinoidal remains, Salter, Trans. Geol. Soc., ser. 2, vol. vii, p. 223, pl. xxv, figs. 21–28.

Salter figured (but did not describe in detail) various stems and stem-joints of crinoids from the Bokkeveld Beds. Several distinct types can be recognised, and they probably belong to more than one genus. Such imperfect material is represented in all the collections of Bokkeveld fossils from various localities, but detailed descriptions of it are not of much value.

* Clarke, Foss. devon. Parana, 1913, p. 315, pl. xxviii, figs. 9–12.

† Kozłowski, Ann. Paléont., vol. xii, 1923, p. 100, pl. x, fig. 22.

‡ Clarke, Foss. devon. Parana, 1913, p. 312, pl. xxvii, figs. 1–8.

§ Kozłowski, Ann. Paléont., vol. xii, 1923, p. 99, pl. x, fig. 21.

|| Wachsmuth and Springer, "Revision of Palaeocrinoidea," Proc. Acad. Nat. Sc. Philadelphia, 1879, p. 320; *ibid.*, 1881, p. 407.

¶ Bather in Lankester's Treatise on Zoology, pt. 3, 1900, p. 201.

BRYOZOA.

Fenestella sp.

Only one representative (74f S.A. Mus.) of this genus has been recognised in all the collections of Bokkeveld fossils, and this consists of the base of a zoavium and a few branches. The branches are small, parallel, and much thicker than the dissepiments which are set at equal distances apart and form subquadrate or rounded fenestrules longer than wide. Traces of cells can be seen on the branches, and in a length of 6 mm. there are 6-7 fenestrules.

Monotrypa ? sp.

On the same piece of rock (11358) from Leo Hoek, in the British Museum, as that containing the impression of a coarsely rugate *Grammysia* (*Gr. corrugata* ?), there is a portion of a corallum of a small monticuliporoid consisting of small polygonal cells, a few of which seem to be larger and to form indefinite maculae. The only such fossil from the Lower Devonian of the southern hemisphere is *Monotrypa raritabulata* Knod,* described from Bolivia, but ours can hardly be considered identical with it.

BRACHIOPODA.

Lingula Keideli, Clarke.

1903. *Lingula* aff. *densa* Reed (pars), Ann. S. Afr. Mus., vol. iv, pt. 3, No. 7, p. 167, pl. xx, fig. 1 (120 S.A. Mus.) (*non* fig. 2).

1913. *Lingula Keideli* Clarke, "Foss. devon. Parana," p. 309, pl. xxvi, figs. 8-10.

One (120 S.A. Mus.) of the specimens which the author figured in 1903 as a form allied to *Lingula densa* Hall, may be attributed without any hesitation to *Lingula Keideli* Clarke, described from Brazil. In my figure the beak is made rather too obtuse, and should be more acute, as shown in one of Clarke's specimens, fig. 8. It agrees very closely with Kozłowski's † Bolivian shell which he referred to *L. densa* Hall, and probably is identical with it.

Lingula lepta, Clarke.

1903. *Lingula* aff. *densa* Reed (pars), Ann. S. Afr. Mus. vol. viii, pt. 3, No. 7, p. 167, pl. xx, fig. 2 (123 S.A. Mus.) (*non* fig. 1).

* Knod, Neues Jahrb. f. Miner., Beil. Bd. xxv, 1908, p. 560, t. xxxi, figs. 1, 2.

† Kozłowski, "Foss. devon. Brésil," Ann. Paléont., vol. viii, 1913, p. 3, pl. i, figs. 3-10.

1913. *Lingula lepta*, Clarke, "Foss. devon. Parana," p. 308, pl. xxvi, figs. 3-7.

1913. *Lingula* cf. *Manni*, Kozłowski, "Foss. devon. Brésil," Ann. Paléont., vol. viii, p. 2, pl. i, figs. 1, 2.

Clarke and Kozłowski have identified the South African shells, which the author in 1903 considered allied to *L. densa* Hall, with Brazilian species; the former gives one a new specific name, but the latter only compares it with the North American species *L. manni* Hall. Both, however, were misled in placing both my figured specimens in the same species, for the second figured one (123 S.A. Mus.) (E. 783 Stell. Mus.) has a much more truncate anterior end than the first one (No. 120 S.A. Mus.) (*op. cit.*, fig. 1), which is referable to Clarke's other species, *L. keideli*. Through the kindness of Dr. du Toit I have been able to compare the specimens with examples which he collected in Brazil. There are specimens in the South African Museum (169a, 5415) from Uitvlugt, Montagu, and one in the Stellenbosch Museum (E. 783), which are referable to this species. Another (124) from Tunnel Siding is in the Sedgwick Museum.

Lingula scalprum, Clarke.

(Pl. IV, fig. 3.)

1913. *Lingula scalprum* Clarke, "Foss. devon. Parana," Mon. Serv. Geol. Miner. Brasil, vol. i, p. 310, pl. xxvi, figs. 1, 2.

1923. *Lingula scalprum* Kozłowski, "Foss. devon. Bolivie," Ann. Paléont., vol. xii, p. 81, pl. ix, fig. 25.

There is one good specimen (H. 67 Stell. Mus.) from Hottentot's Kloof, Ceres, which is undoubtedly identical with Clarke's small species *L. scalprum* from Brazil. Kozłowski regards one of the specimens from Bolivia which Knod* included in his *L. subpunctata* as belonging to Clarke's *L. scalprum*.

Lingula (Glossina?) sp.

1903. *Lingula* sp. Reed, Ann. S. Afr. Mus., vol. iv, pts. 3, 7, p. 167, pl. xx, fig. 3 (121 S.A. Mus.).

The small undetermined species of *Lingula* figured by the author from Hottentot's Kloof, Ceres, is of doubtful reference, and may belong to the subgenus or genus *Glossina* Phillips, for it suggests in

* Knod, Neues Jahrb. f. Miner., Beil. Bd. xxv, 1908, p. 536, t. xxvi, fig. 7 (*non* fig. 8).

shape *G. acer* Clarke * from the Grande Grève Limestone of Gaspé, and its allies *L. perlata* Hall, and *L. spatiosa* Hall, of the Helderbergian.

Orbiculoidea (Roemerella) cf. collis, Clarke.

(Pl. IV, figs. 9, 9a.)

There is a large high capuliform brachial valve (6716 S.A. Mus.) of a species of *Orbiculoidea* from the farm Driefontein, Clanwilliam, in the South African Museum, which seems to be comparable to the Brazilian species *O. collis* Clarke † and to *O. montis* Clarke, ‡ from the Grande Grève Limestone of Gaspé. Our specimen is somewhat distorted, having been compressed in an antero-posterior direction, so that it measures about 45 mm. in height, about 55 mm. in its antero-posterior diameter, and about 73 mm. in its transverse diameter. The apex is blunt and eccentric, being somewhat nearer the posterior side, towards which it curves slightly back and descends steeply in a gentle concave curve; the anterior slope is gently arched and convex and also descends steeply, but less so than the posterior face. The shell is ornamented with regular equidistant sharp raised concentric lines which have fine concentric striae in the concave interspaces between them. The surface of the shell is also marked with 5–6 broad flat concentric bands of equal width at distances of every 9–12 concentric lines, indicating periods of growth. Closely placed low rounded equidistant radial lines are visible also on the anterior and posterior slopes of the valve, but they belong to an inner layer of the shell, as may be plainly seen below the apex on the posterior face.

Orbiculoidea (Roemerella) Baini (Sharpe) (emend.).

- 1846. *Orbicula* sp. Morris and Sharpe, Proc. Geol. Soc., pl. x, fig. 5, p. 277.
- 1856. *Orbicula Baini* Sharpe (pars), Trans. Geol. Soc., vol. v, pt. 7, p. 210, pl. xxvi, figs. 21–23 (*non* fig. 20, *nec* diagnosis) (11333, 11334, 11335 Brit. Mus.).
- 1903. *Orbiculoidea Baini* Reed, Ann. S. Afr. Mus., vol. iv, pt. 4, p. 168, pl. xx, figs. 4, 5, (158 S.A. Mus.).
- 1913. *Orbiculoidea Baini* Kozłowski, "Foss. devon. Parana," Ann. Paléont., vol. viii, p. 4, pl. i, figs. 11–13.

* Clarke, Mem. No. 9, New York State Mus., pt. 1, 1908, p. 214, pl. xlvii, figs. 7, 8.

† Clarke, Foss. devon. Parana, 1913, p. 306, pl. xxv, figs. 23–26.

‡ Clarke, Mem. 9, New York State Mus., pt. 1, 1908, p. 213, pl. xlvii, figs. 21–24.

1913. *Orbiculoidea Baini* Clarke, "Foss. devon. Parana," p. 301, pl. xxv, figs. 5-15.

1916. *Orbiculoidea (Roemerella) Baini*, Williams and Breger, Prof. Paper 89 U.S. Geol. Surv., p. 24.

The shell figured by Sharpe in 1856 (fig. 20, *op. cit.*) as a "small specimen," and showing the very fine radial striation which is not present in any of the others, is quite distinct from the shell from the Falkland Isles figured by him in 1846 as *Orbicula* sp., but not named or described at that time. The latter agrees with the shells usually termed *O. Baini*, and as such figured by Sharpe in 1856 (figs. 21-23, *op. cit.*). These have been regarded as typical of the species, and it seems, therefore, inadvisable to substitute a new name for this common form after it has been for so long in general use. But Sharpe's definition is poor and misleading, as he refers to radial striae which are different in nature to those on his "small specimen" (*op. cit.*, fig. 20), as they are on the inner surface or layer of the shell and therefore only visible when the shell is more or less removed or flaked off. Clarke, in 1913 (*op. cit.*), remarked that the Parana shells are wholly devoid of the fine radial surface striation which Von Ammon's * *Discina Baini*, from Matto Grosso, possessed, this shell probably belonging to the same genus, if not species, as *Palaeoscurria Sharpei* (q.v.).

In the common Bokkeveld shell illustrated by Sharpe's other figures, 21 to 23 (*op. cit.*), the shell is circular, and the upper (brachial) valve forms a low flattened cone, with the apex subcentral, acute, and elevated to a height equal to almost one-fourth or one-third the diameter. The pedicle valve is slightly concave, and the pedicle foramen is large, oval, and sunken. The surface of the brachial valve, which is usually the one preserved, is covered with sharp equidistant narrow ridges, usually regular and of equal strength, while radial striae are completely absent on the exterior, as Clarke remarked (*op. cit.*), only decorticated specimens showing fine, widely-spaced, radial markings, as may be seen in the British Museum specimen (No. 11333) figured by Sharpe (*op. cit.*, fig. 21). Williams and Breger † compare this species with their *O. (Roemerella) discus* from the Chapman Sandstone of Maine, and probably *Discina mediorhenana* Fuchs, ‡ from the Hunsruck States, and *Orbiculoidea siegenensis* (Kayser), §

* Von Ammon, Zeitschr. Gesell. Erdkunde, vol. xxviii, 1893, p. 359, fig. 4.

† Williams and Breger, Prof. Paper 89 U.S.A. Geol. Surv., 1916, p. 21, pl. vi, figs. 29-33 (? 28).

‡ Fuchs, Abh. k. preuss. geol. Landesanst., 1915, Heft 75, p. 6, t. i, figs. 6-8.

§ Kayser, Jahrb. geol. Landesanst., 1890, p. 95, pl. xi, figs. 1, 2.

from the Siegen Grauwacke and the Siluro-Devonian of Lievin * are allied species.

Orbiculoidea? aberrans sp. nov.

(Pl. IV, figs. 4, 4a.)

Shell slightly obovate, widening a little anteriorly. Brachial valve flat with small, low, rather suddenly raised, sharp, conical apex, situated at about one-sixth the length of the valve from the posterior end. Surface of valve covered with regular equidistant thin flat concentric laminae of equal strength, having their surface slightly undulated or weakly pitted, and all crossed by very delicate close radial striae. Substance of shell thin, corneous.

Dimensions (289 *a, b*, Univ. Cape):—

Length 18.0 mm.

Width (max.) . . . 16.5 mm.

Remarks.—There is only one specimen of this interesting shell which was collected from Keurbosch, Hex River district, and it is in the Cape University Collection (289 *a, b*). The impression of the exterior is also preserved. The pitting or undulation of the surface of the successive laminae gives a peculiar frilled appearance under a lens. The true generic position is questionable, but it somewhat resembles *Schizobolus truncatus* (Hall) † of the black Genesee shales of New York, a species which Clarke ‡ also records and figures from the Devonian of Brazil.

Orthis (Dalmanella) satelles sp. nov.

(Pl. IV, fig. 5.)

Shell transversely subcircular, rather wider than long, plano-convex or concavo-convex; cardinal angles rounded; hinge-line short, about half width of shell. Pedicle valve gently convex; beak small, elevated, with lateral edges inclined at about 120°; hinge-area triangular, of moderate size, concave, inclined nearly at right angles to plane of valve. Brachial valve flattened or slightly concave, with a more or less distinct broad shallow median sulcus. Surface of valves covered with numerous primary subangular equal riblets, gently curved back near cardinal angles, increasing by rare intercalation of shorter ribs to 50–60 on margins.

* Barrois, Pruvost, and Dubois, *Mém. Soc. Geol. Nord*, vi, 2, fasc. 2, 1920, p. 76, pl. x, figs. 13, 14.

† Hall and Clarke, *Palaeont. New York*, vol. viii, Brach. I, p. 87, pl. iii, figs. 11–14.

‡ Clarke, *op. cit.*, 1913, p. 325, pl. xxv, figs. 1–4.

Dimensions :—

	(7203 S.A. Mus.)	(138a S.A. Mus.)
Length . . .	11.0 mm.	10.5 mm.
Width . . .	14.5 mm.	13.5 mm.

Remarks.—Several specimens of this species of *Orthis* occur in the South African Museum (138a, 7203, 15), collected 200 yds. from Triangle Station and (6721 S.A. Mus.) from Gydo Pass, and there is one also in the Pretoria Museum (414 Pret. Mus.) from Ezelfontein, Ceres. It is allied to, but hardly identical with, *O. (Dalm.) Pradoi* Kozl.* from the Bolivian Devonian, and it resembles also *O. (Dalm.) lucia* Billings † of the North American Lower Devonian. Williams and Breger ‡ put *O. (Dalm.) plano-conveza* Hall, of the Lower Helderberg, Oriskany, and Chapman Sandstone, in the same genus as *O. lucia*, and consider it almost indistinguishable from the European Lower Devonian species commonly called *O. orbicularis* Sow.

Stropheodonta Arcei (Ulrich).

(Pl. IV, fig. 11.)

1856. *Chonetes* ? sp. Sharpe (pars), Trans. Geol. Soc., ser. 2, vol. vii, p. 210 ("from nodule of reddish rock").
1893. *Chonetes Arcei* Ulrich, Neues Jahrb. f. Miner., Beil. Bd. viii, p. 77, pl. iv, figs. 35, 36.
1903. *Chonetes* cf. *Arcei* Reed, Ann. S. Afr. Mus., vol. iv, pt. 3, p. 173, pl. xxi, fig. 3 (129 S.A. Mus.).
1908. *Stropheodonta Arcei* Knod, Neues Jahrb. f. Miner., Beil. Bd. xxv, p. 539.
1913. *Stropheodonta* cf. *Arcei* Kozłowski, "Foss. devon. Brésil," Ann. de Paléont., vol. viii, p. 6, pl. xii (2), figs. 3, 4.

This species, which was put in the genus *Chonetes* by its founder, was transferred to *Stropheodonta* by Knod, and Kozłowski (*op. cit.*) adopts this reference. With this view I am in agreement. The specimen (129 S.A. Mus.) which I figured in 1903 as comparable to this Bolivian species may, without much doubt, be assigned to it, and there are some specimens in the British Museum (B. 45502, 11357) from Warm Bokkeveld which show all the characters distinctly, and include the

* Kozłowski, *op. cit.*, 1923, p. 82, pl. x, figs. 17, 18.

† Clarke, Mem. 9, New York State Mus., pt. 1, 1908, p. 204, pl. xlv, figs. 8–20.

‡ Williams and Breger, *op. cit.*, 1916, p. 57, pl. vi, fig. 17; pl. vii, figs. 10, 11, 13, 14, 16–18, 20–22, 24–30.

specimen mentioned by Sharpe (*op. cit.*) as *Chonetes?* sp. Clarke * does not consider that Knod is justified in referring this species to *Stropheodonta*, and the Argentine shell described by Thomas † as *Chonetes Arcei*, and possessing a denticulate hinge-line, is regarded by Clarke as “clearly an *Eodevonaria*,” which is a subgenus of *Chonetes*.

Stropheodonta cf. Katzeri, Knod.

(Pl. IV, fig. 10.)

? 1856. *Chonetes* sp. ind. Sharpe (pars), Trans. Geol. Soc., ser. 2, vol. vii, p. 210.

? 1893. *Strophomena* sp. *α*, Ulrich, Neues Jahrb. f. Miner. Geol., Beil. Bd. viii, p. 70, t. iv, fig. 23.

1893. *Strophomena* sp. *β*, Ulrich, *op. cit.*, p. 70, t. iv, fig. 24.

1903. *Strophonella* sp. Reed, Ann. S. Afr. Mus., vol. iv, pt. 3, p. 169, pl. xx, fig. 7 (128 S.A. Mus.).

1908. *Stropheodonta Katzeri* Knod, Neues Jahrb. f. Miner. Geol., Beil. Bd. xxv, p. 538, t. xxvii, figs. 1–3a.

There is one good example of the interior of a pedicle valve in the Stellenbosch Museum (H. 196 Stell. Mus.) from 2 miles N.E. of Ceres, measuring about 43 mm. in width and 29 mm. in length. It shows the internal characters well, especially the coarse radial pustulation as illustrated by Knod and Ulrich in his sp. *β*. Some specimens in the British Museum from the Warm Bokkeveld more resemble Ulrich's sp. *α*, which Knod would include in *Str. Katzeri*. The coarsely radiate, indefinite, large, diductor muscle-scars are well seen in some other specimens just as Knod figures and describes them. If Knod is correct in referring Ulrich's *Strophomena* sp. *α* to *Str. Katzeri*, we may, without much hesitation, place in it the Bokkeveld fossil termed *Strophonella* sp., which the author figured under that name in 1903. Certain poor specimens from Hottentot's Kraal (3903, 3904, 3923, S.A. Mus.) which were at first thought to be comparable with *Chonetes Hallei* Clarke,‡ from the Falkland Isles, may also be doubtfully included in *Str. Katzeri*. Knod (*op. cit.*) compares his species with *Str. magnifica* Hall § of the Oriskany Formation.

* Clarke, Foss. devon. Parana, 1913, p. 290.

† Thomas, Zeitschr. deut. geol. Gesell., vol. lvii, 1905, p. 258, t. xiii, figs. 26a–c.

‡ Clarke, *op. cit.*, 1913, p. 293, pl. xxiv, fig. 34.

§ Hall, Palaeont. New York, vol. iii, 1859, pp. 414, 482, pl. xciii, fig. 4; pl. xciv, fig. 2; pl. xciv, fig. 8; pl. xcva, figs. 15–19.

Stropheodonta (Leptostrophia) concinna (Morris and Sharpe).

1903. *Stropheodonta* cf. *concinna*, Reed, Ann. S. Afr. Mus., vol. iv, pt. 3, p. 169, pl. xx, fig. 6 (131 S.A. Mus.).

1913. *Leptostrophia concinna*, Clarke, "Foss. devon. Parana," p. 285, pl. xxiii, figs. 1-4.

It may be doubted, according to Clarke,* if this species is really allied to *Str. (Lept.) perplana* Conr., and the identification of the latter species in Bolivia is questionable. Knod,† however, considers them to be very closely allied, and Williams and Breger ‡ put them as identical, or as belonging to the same genus, but with a query. It appears to be a very rare form in the Bokkeveld Beds.

Schuchertella Sulivani (Morris and Sharpe).

1903. *Orthothetes Sulivani* Reed (pars), Ann. S. Afr. Mus., vol. iv, pt. 3, p. 170, pl. xx, fig. 8 (113 S.A. Mus.) (for earlier references).

1913. *Schuchertella Sulivani* Clarke, "Foss. devon. Parana," p. 279, pl. xxiii, figs. 16-23.

The two specimens (11330, 11331 Brit. Mus.) which Sharpe figured from the Bokkeveld Beds are from the Warm Bokkeveld, and specimens from other localities are fairly common in the South African Museum and in other collections.

With regard to its affinities, Clarke § does not agree with the author's suggestion that *S. Agassizi* (Hartt) is probably identical with it, and he separates the Brazilian form as a distinct species, and Kozłowski || likewise keeps the name *S. Agassizi* for certain Bolivian shells which Knod ¶ had referred to *O. chemungensis*. Williams and Breger ** consider that *S. Sulivani* belongs to the same group as the European *S. hipponyx* (Schnur). The shell which has been described as *S. pecten* from the Siluro-Devonian rocks of Lievin †† may also be allied.

* Clarke, *op. cit.*, 1913, p. 289.

† Knod, *op. cit.*, 1908, p. 540, t. xxvii, fig. 4.

‡ Williams and Breger, *op. cit.*, 1916, p. 27.

§ Clarke, *op. cit.*, 1913, p. 276, pl. xxiii, figs. 5-13.

|| Kozłowski, *op. cit.*, 1923, p. 85, pl. ix, fig. 30.

¶ Knod, *op. cit.*, 1908, p. 541, pl. xxvi, figs. 13, 14; pl. xxvii, figs. 5, 7.

** Williams and Breger, *op. cit.*, 1916, p. 39.

†† Barrois, Pruvost, and Dubois, Mém. Soc. Geol. Nord, vi, 2, fasc. 2, 1920, p. 82, pl. xii, figs. 4, 5.

Schuchertella ? Baini (Sharpe).

1856. *Strophomena Baini* Sharpe, Trans. Geol. Soc., ser. 2, vol. vii, p. 208, pl. xxvi, fig. 13 (11325 Brit. Mus.), fig. 17 (11329 Brit. Mus.).
1903. *Orthothetes Sulivani* Reed (pars), Ann. S. Afr. Mus., vol. iv, pt. 3, p. 170 (*non* pl. xx, fig. 8).
- ? 1908. *Orthothetes chemungensis* Knod, Neues Jahrb. f. Miner. Geol., Beil. Bd. xxv, p. 541, t. xxvi, figs. 13, 14, 14a.

The type of *Sch. Baini* (Sharpe) which is in the British Museum (11325) is a brachial valve from the Warm Bokkeveld, which precisely agrees with Knod's figure of a Bolivian shell which he attributes to *O. chemungensis* Conr. Kozłowski * considers this Bolivian shell to belong to *Sch. Agassizi* (Hartt), and puts Clarke's *Sch. Agassizi* from Brazil with it, including them all under the latter name, but he does not quote Sharpe's *Sch. Baini* in the synonymy. In 1903 the author was inclined to consider *Sch. Baini* as inseparable from *Sch. Sulivani*; but the latter is a more compressed and more subcircular or sub-quadrate form and has coarser radial riblets, and is more likely to be identical with *Sch. Agassizi*; Kozłowski's and Clarke's figures of this species show these characters well. The absence in *Sch. Sulivani* of the decided bilobation of the brachial valve, which is a marked feature in *Sch. Baini*, is another distinction. But we know nothing of its internal characters. Sharpe's figure 13 (11325 Brit. Mus.) makes the radii too fine, and there are only about 120 on the surface; these have reached this number by intercalation of rather finer ones at various distances from the beak. This specimen measures 25 mm. in width and 18 mm. in length. The other figured specimen (*op. cit.*, fig. 17, 11329 Brit. Mus.) is an impression of a valve on the same piece of rock, and is of larger size, but it is broken and has rather coarser radii and more obtuse cardinal angles, and it may belong to another species.

Chonetes falklandicus, Morris and Sharpe.

1903. *Chonetes falklandicus* Reed, Ann. S. Afr. Mus., vol. iv, pt. 3, p. 171, pl. xx, figs. 9, 10 (136, 127 S.A. Mus.) (for earlier references).
1908. *Chonetes falklandicus* Knod, Neues Jahrb. f. Miner., Beil. Bd. xxv, p. 545.

* Kozłowski, *op. cit.*, 1923, p. 85, pl. ix, fig. 30.

1913. *Chonetes falklandicus* Clarke (pars), "Foss. devon. Parana," p. 295, pl. xxiv, figs. 8, 12, 14, 22, 23 (? *non cet.*).
 ? 1913. *Chonetes falklandicus* Kozłowski, Ann. Paléont., vol. viii, p. 7, pl. xii (2), fig. 5.

Clarke included under this name a series of specimens from the Devonian of Brazil which showed a considerable range of variation, and, judging from his figures, there may be more than one species present. Specimens from the Falkland Isles (3223, 3222 Alb. Mus.) in the Grahamstown Museum, and others from Brazil in Dr. du Toit's collection in Cape Town, have enabled me to make a comparison with the Bokkeveld material, and it has not led me to adopt Clarke's wide interpretation of this species.

It is probable that one (11324 Brit. Mus.) at any rate of the specimens figured by Sharpe * from the Warm Bokkeveld as *Chonetes* sp. indet. may be referred to *Ch. falklandicus*, and it is not unlikely that the others (11326, 11327 Brit. Mus.) also figured by him (*op. cit.*, figs. 15, 16) should be associated; but they are poorly preserved.

As Williams and Breger † have remarked, the North American species, *Ch. novascoticus* Hall, ‡ and the European *Ch. sarcinulatus* Auctt., are allied to *Ch. falklandicus*, and we may also mention *Ch. canadensis* Billings, § from the Grande Grève Limestone of Quebec, in this connection.

Chonetes Rücki Ulrich, var. nov. *medialis*.

(Pl. IV, figs. 7, 8.)

Shell flattened, semi-elliptical; cardinal angles subrectangular; cardinal line equal to width of shell, armed with 3 long spines on each side of beak, directed nearly at right angles to hinge-line, with the longest one nearest the cardinal angle; surface of shell covered with fine low rounded thread-like radii, increasing by intercalation and bifurcation to 100–120 on margin, with one stronger median radius. Pedicle valve with short thin median septum, and pair of short broadly flabelliform rounded diductors about one-fourth the length of the valve; interior covered with radial lines of small equal equidistant punctae.

* Sharpe, Trans. Geol. Soc., ser. 2, vol. vii, 1856, pl. xxvi, fig. 14.

† Williams and Breger, *op. cit.*, 1916, p. 47.

‡ *Ibid.*, p. 45, pl. ix, figs. 11, 12, 15, 16, 19; pl. x, figs. 1–3, 5–16, 18–29, 32, 33 (and references).

§ Clarke, Mem. 9, New York State Mus., pt. 1, 1908, p. 205, pl. xlv, figs. 16–27.

Dimensions (207 Univ. Cape) :—

Length . . .	8.0 mm.
Width . . .	10.0 mm.

Remarks.—The impression and internal cast of a pedicle valve of a small species of *Chonetes* (207 Univ. Cape) from Touws River Road, Upper Hex River Valley, may probably be regarded as a variety of *Ch. Rücki* Ulrich,* to which Ulrich (*op. cit.*) considered that *Ch. coronata* Conr. was allied, and that probably *Ch. Comstocki* Hartt, from the Devonian of Brazil, was identical. But the median rib in ours recalls *Ch. aroostookensis* Clarke † from the Chapman Sandstone of Maine. Some of Clarke's ‡ Brazilian specimens attributed to *Ch. falklandicus* appear to bear a considerable resemblance to our form.

Chonetes Stübeli, Ulrich.

1893. *Chonetes Stübeli* Ulrich, Neues Jahrb. f. Miner., Beil. Bd. viii, p. 80, t. v, figs. 3, 4.

1903. *Chonetes* aff. *setiger* Reed, Ann. S. Afr. Mus., vol. iv, pt. 3, p. 174, pl. xxī, fig. 4 (5 ?) (126 S.A. Mus.).

1908. *Chonetes Stübeli* (Ulrich ?) Knod, Neues Jahrb. f. Miner., Beil. Bd. xxv, p. 546.

From a further examination of the specimens (126 S.A. Mus.) from the Witzenberg Valley, Ceres, which I regarded as allied to *Ch. setiger* Hall, and from better acquaintance with the latter species, it is practically certain that the Bokkeveld shells should be referred to *Ch. Stübeli* Ulrich of the Bolivian Devonian, a species which its author considers allied to *Ch. mucronata* Hall, and that they should not be placed with *Ch. coronata* Conr., as Clarke § thinks. Some of the more coarsely ribbed shells from Brazil figured by Clarke || as *Ch. falklandicus* Morr. and Sh., may possibly be referred to *Ch. Stübeli*. The species *Ch. vicinus* Cast. and *Ch. Billingsi* Clarke, ¶ both of the North American Lower Devonian, belong to the same group of species as *Ch. mucronata*, and the variety of *Ch. vicinus* Cast. from the Chapman Sandstone figured by Williams and Breger ** as *deflecta* Hall, bears a great resem-

* Ulrich, Neues Jahrb. f. Miner. Geol., Beil. Bd. viii, 1893, p. 79, t. v, figs. 1, 2.

† Clarke, Mem. 9, New York State Mus., pt. 2, 1909, p. 120, pl. xxx, figs. 20–25.

‡ Clarke, Foss. devon. Parana, 1913, pl. xxiv, figs. 19, 24 (*non cet.*).

§ *Ibid.*, pp. 299, 300.

|| *Ibid.*, pl. xxiv, figs. 3, 4, 5.

¶ Clarke, Mem. 9, New York State Mus., pt. 1, pp. 209, 238, pl. xli, figs. 18–30.

** Williams and Breger, *op. cit.*, p. 49, pl. iii, fig. 8.

blance to the South African shell. Our figured specimen (126 S.A. Mus.) shows the cardinal spines distinctly. Another specimen in the Sedgwick Museum, collected by Dr. Rastall from De Doorns, consists of the impression of the exterior of the pedicle valve beautifully preserved.

Chonetes cf. *Hallei*, Clarke.

(Pl. IV, fig. 12.)

1856. *Chonetes* ? sp. Sharpe (pars); Trans. Geol. Soc., ser. 2, vol. vii, p. 210.

1913. *Chonetes Hallei*, Clarke, "Foss. devon. Parana," p. 293, pl. xxiv, fig. 34.

On a reddish nodule from Warm Bokkeveld in the British Museum (B 45502) there is the impression of the interior of a nearly perfect brachial valve of a subquadrate shell which seems almost indistinguishable from *Chonetes Hallei* Clarke, from the Falkland Islands. The marginal band of fine radial lines of pustules, the much coarser pustulation of the inner portion of the valve, the course and strength of the brachial ridges, the dental sockets and adductor muscle-scars, agree completely. But there is a more distinct low median septum in our specimen, and the large stout cardinal process is bilobed, not trilobed, as Clarke states. It does not seem that this is a true *Chonetes*.

Dimensions :—

Length	.	.	.	c. 32 mm.
Width	.	.	.	20 mm.

Chonetes sp.

1903. *Chonetes* cf. *coronatus*, Reed, Ann. S. Afr. Mus., vol. iv, pt. 3, p. 172, pl. xx, figs. 11, 12; pl. xxi, figs. 1, 2 (112, 118 S.A. Mus.).

The rather distorted poor casts (112, 118 S.A. Mus.) from Boschluis Kloof, which the author in 1903 compared with *Ch. coronatus* Hall, are certainly different to those from Argentina identified by Thomas * as belonging to this species. Clarke † considered my comparison to be hazardous, and Thomas' Argentine shells are more allied to *Ch. falklandicus* and *Ch. Rücki* Ullr. from Bolivia. But Ulrich ‡ himself remarked that the latter stood near *Ch. coronatus*. Some of the specimens figured by Clarke § from the Falkland Islands under the

* Thomas, Zeitschr. deut. geol. Gesell., vol. lvii, 1905, p. 259, t. xix, figs. 39, 40.

† Clarke, *op. cit.*, 1913, p. 301.

‡ Ulrich, *op. cit.*, 1893, p. 79, t. v, figs. 1, 2.

§ Clarke, *op. cit.*, 1913, p. 291, pl. xxiv, figs. 26–33.

new specific name *Ch. Skottsbergi*,—a form which he considers allied to the Hamilton species *Ch. coronatus* Hall and *Ch. syrtalis* Hall, and to *Ch. canadensis* Billings of the Grande Grève Limestone and Chapman Sandstone—somewhat resemble our Bokkeveld specimens, which are too poor for a satisfactory determination. Raymond's * series of specimens illustrating the developmental changes of *Ch. coronatus* include some (*op. cit.*, pl. xvi, rows 3 and 4) much resembling our shells.

Chonetes (Eodevonaria) aff. arcuata, Hall.

(Pl. IV, fig. 13.)

One internal cast of a pedicle valve (C 10) occurs in the Stellenbosch Museum in an unusually good condition, but unfortunately its locality is unknown. The valve is transversely semi-elliptical with subrectangular cardinal angles; its surface is uniformly convex, and it is rather inflated in the antero-posterior direction. The beak is small, pointed, and incurved. The teeth are short and stout; the diductor muscle-scars are large and subcircular, more than half the length of the shell, and there is a low median septum between them, thickened in the middle and extending about four-fifths the length of the valve, dying out gradually anteriorly. Behind the diductor muscle-scars and between them and the hinge-line are transverse laterally extended sublanceolate smooth areas representing internal thickenings of the shell. There are about 150 fine equal radial thread-like lines on the surface of the shell, increasing near the margin by intercalation (and bifurcation?), and on the cast lines of small equidistant punctae lie between them. The hinge-line does not show any distinct cardinal spines, and there are only doubtful traces of fine crenulations on the hinge-line. But on another specimen from Boschluis Kloof in the Sedgwick Museum the oblique crenulations are distinctly visible, as in *Ch. arcuata* Hall of the Corniferous Limestone, and *Ch. hudsonica* Clarke † of the Oriskany and Gaspé Sandstones, particularly the *Ch. cf. arcuata* of the Oriskany of New York figured by Clarke.‡ One of the shells from Brazil figured by Clarke § as belonging to *Ch. falklandicus*, but quite different to the ordinary form of that species, bears a considerable resemblance. The European

* Raymond, Amer. Journ. Sc., vol. xvii, 1904, p. 289, pl. xvi.

† Clarke, Mem. 9, New York State Mus., pt. 1, 1908, p. 238, pl. xlv, figs. 6-15.

‡ *Ibid.*, pt. 2, 1909, p. 144, pl. xxxiv, figs. 21-31; Kindle, Bull. 508, U.S. Geol. Surv., 1912, p. 73, pl. iii, figs. 9-12.

§ Clarke, Foss. devon. Parana, 1913, pl. xxiv, fig. 18 (*non cet.*).

species *Ch. dilatata* Roem.* from the Coblenzian belongs to the same group as *Ch. arcuata*, as Williams and Breger have observed.†

Spirifer antarcticus, Morris and Sharpe.

1842. *Spirifer antarcticus* Morris and Sharpe, Quart. Journ. Geol. Soc., vol. ii, p. 276, pl. xi, fig. 1.
 ? 1846. *Spirifer orbignii*, Morris and Sharpe, *ibid.*, p. 276, pl. xi, figs. 3a, b, c.
 1856. *Spirifer antarcticus* Sharpe, Trans. Geol. Soc., ser. 2, vol. vii, p. 206, figs. 1, 2, 5.
 1856. *Spirifer orbignii* Sharpe, *ibid.*, p. 207, pl. xxvi, figs. 3, 4, 6.
 1893. *Spirifer chuquisaca* Ulrich, Neues Jahrb. f. Miner. Geol., Beil. Bd. viii, p. 65, t. iv, figs. 19, 20 a-c.
 ? 1897. *Spirifer antarcticus* Kayser, Zeitschr. deut. geol. Gesell., vol. xlix, p. 297, t. ix, figs. 1-4.
 1903. *Spirifer orbignyi* Reed (pars), Ann. S. Afr. Mus., vol. iv, pt. 3, p. 180 (*non* pl. xxii, fig. 4).
 1903. *Spirifer* cf. *pedroanus* Reed, *ibid.*, p. 183, pl. xxii, fig. 5 (160 S.A. Mus.).
 1905. *Spirifer antarcticus*, Thomas (pars), Zeitschr. deut. geol. Gesell., Bd. lvii, p. 261, t. xiii, figs. 22-24 (*non* f. 25).
 1906. *Spirifer antarcticus* Newton, Proc. Roy. Phys. Soc. Edin., vol. xvi, p. 252, pl. x, figs. 1-10.
 1906. *Spirifer antarcticus* Schwarz (pars), Rec. Albany Mus., vol. i, pt. 6, p. 371 (*non* pl. vii, figs. 1, 2).
 1908. *Spirifer orbignyi* Reed, Ann. S. Afr. Mus., vol. iv, pt. 8, p. 399.
 1908. *Spirifer arrectus* var. *antarcticus* Knod, Neues Jahrb. f. Miner. Geol., Beil. Bd. xxv, p. 549, t. xxviii, figs. 3, 3a.
 1908. *Spirifer arrectus* var. *acuticostatus* Knod, *ibid.*, p. 547, t. xxviii, fig. 2.
 1913. *Spirifer antarcticus* Clarke, "Foss. devon. Parana," p. 258, pl. xviii, figs. 1-14 (*non* 15, 16).
 1923. *Spirifer antarcticus* Kozłowski, "Faune dev. Bolivie," Ann. Paléont., vol. xii, p. 93.

The above is a revised synonymy, for the author has been led to modify his views since 1903. Clarke (*op. cit.*, 1913, pp. 230, 231) considers that *Sp. orbignyi* Morris and Sharpe was so inadequately

* Fuchs, "Hunsrucksch. u. Unterkoblenzsch. am Mittelrhein," Abh. k. preuss. geol. Landesanst. N.F., Heft 79, 1915, p. 19, t. iv, figs. 3-10.

† Williams and Breger, *op. cit.*, 1916, pp. 53, 54, pl. iii, figs. 6, 9, 11.

defined that its true characters are questionable, and that though the specific name has been thought to have the priority of *antarcticus*, it is best to employ the latter name with which the South African shells certainly agree. With this view most authors concur, and the present author feels therefore bound to do so also and abandon his earlier position. Newton (*op. cit.*, 1906) arrived at the same conclusion. The classification of the South African forms is, however, less easy than that of the South American shells, for which Clarke relies chiefly on their ornamentation. But unfortunately most of the Bokkeveld specimens do not show it and occur as internal casts. Thus considerable difference of opinion may reasonably exist as to their reference and relation.

In 1907* the author expressed the view that the shell which he had previously termed *Sp. cf. pedroanus* might be only a variety of *Sp. antarcticus*. Clarke, however, thinks that it approaches *Sp. Hawkinsi* Morris and Sharpe (though this species has only 3 ribs on each side of the sinus instead of 20-22), while Knod (*op. cit.*) places it in his variety *acuticostatus*. Scupin,† in 1898, pointed out that the group of species comprising *Sp. arrectus* Hall (= *Sp. Murchisoni* Castelnau) was the American representative of the European group containing *Sp. primaevus*, and Clarke,‡ in 1907, declared that both *Sp. antarcticus* and *Sp. orbigny* were merely local expressions of the widely distributed type *Sp. arrectus*. Williams and Breger,§ however, maintain that the typical *Sp. antarcticus* of the Falkland Isles does not belong to the group of *Sp. arrectus* (= *Sp. Murchisoni* Cast.), but rather to the group of *Sp. Hercyniae*, *Sp. Murchisoni* never having more than 8 distinct ribs on each side; and they believe that my *Sp. orbigny* belongs to the type of *Sp. gaspensis* Billings.|| But my *Sp. cf. pedroanus* is more of the type which belongs (as Clarke ¶ stated) to the *Sp. Murchisoni* group. The varieties of *Sp. Murchisoni* and the South African species are discussed by Williams and Breger (*op. cit.*, pp. 98-104) without coming to any satisfactory conclusion.

Although we may be chary of separating off the South African *Spirifers* into distinct species, we can at any rate recognise certain more or less definite varieties in the somewhat polymorphic or hetero-

* Reed, Geol. Mag., Dec. v, vol. iv, 1907, p. 35.

† Scupin, Zeitschr. deut. geol. Gesell., vol. 1, 1898, p. 462, t. xvii, figs. 2-4.

‡ Clarke, Bull. 107, New York State Mus., pp. 260-263.

§ Williams and Breger, *op. cit.*, 1916, pp. 101-104.

|| Williams and Breger, *ibid.*, p. 107, pl. iv, fig. 7.

¶ Clarke, Mem. 9, New York State Mus., pt. 1, 1908, p. 235, pl. xxxi, figs. 29-38.

geneous group comprised under the name *Sp. antarcticus*, the varieties being distinguishable by their shape and number and character of their ribs rather than by their ornamentation. But it is frequently difficult or impossible to sort the poorly preserved or fragmentary specimens which are commonly obtained from the Bokkeveld Beds into such varieties. Clarke * has insisted that external sculpture is the "most dependable of structural features" in the case of the plicated Eodevonian species, and he considers that most authors have been misled in dealing with the austral members of the genus by neglecting this character. One of the best preserved examples of the minute ornamentation of the surface of a specimen from the Bokkeveld Beds is one in the British Museum (I. 858) from Keurbooms River, Plettenberg Bay, showing the impression of part of a crushed and distorted pedicle valve; the whole surface is covered with fine radial striae crossed by finer concentric lines closely placed and bearing at their intersections small granules or spinules, which thus form regular radial rows, just as Clarke describes, and this type of ornamentation is considered by him as highly distinctive of the austral species.

Spirifer antarcticus, Morris and Sharpe, var. nov. *gamkaensis*.

1903. *Spirifer* sp. *a*, Reed, Ann. S. Afr. Mus., vol. iv, pt. 3, p. 184, pl. xxiii, fig. 2 (146 S.A. Mus.).

1906. *Spirifer orbigny* Schwarz (pars), Rec. Albany Mus., vol. i, pt. 6, p. 370, pl. vii, fig. 4 (2128 Alb. Mus.).

1913. *Spirifer antarcticus* Clarke (pars), "Foss. devon. Parana," p. 562, pl. xviii, figs. 15, 16 (*non cet.*).

This variety has a deeply triangular shell, less transverse than the typical forms of the species; the cardinal angles are broadly pointed or subrectangular; there is a rather narrow median sinus increasing very slowly in width anteriorly, and the subangular or angular ribs on each side of it number 9-10 and are narrow. The median sinus is not equal to more than 2-2½ ribs in width at the margin. The much-extended transverse alate typical form of *Sp. antarcticus* with acutely pointed lateral angles is easily distinguishable from this variety when we have well-preserved specimens to deal with. One of the specimens from the Falkland Isles figured by Newton † as *Sp. antarcticus* appears to belong to this variety, judging from its shape and ribbing. It bears

* Clarke, *op. cit.*, 1913, pp. 222-224.

† Newton, *op. cit.*, pl. x, fig. 4.

a considerable resemblance to *Sp. Murchisoni* Castelnau * of the Lower Devonian of North America. Clarke in 1908 was inclined to think that the differences between the allied forms of *Spirifer* of this group were more constant than he and Scupin had previously believed. But having so many imperfect specimens with transitional characters in the Bokkeveld collections it seems wiser not to separate the South African forms as species.

Spirifer antarcticus Morris and Sharpe, var. *kayseriana*, Clarke.

1856. *Spirifer orbigny* Sharpe, Trans. Geol. Soc., ser. 2, vol. vii, p. 207, pl. xxvi, fig. 1 (*non cet.*).
 1903. *Spirifer orbigny* Reed (pars), Ann. S. Afr. Mus., vol. iv, pt. 3, p. 180, pl. xxii, fig. 4 (147 S.A. Mus.).
 ? 1906. *Spirifer orbigny*, Schwarz (pars), Rec. Albany Mus., vol. i, pt. 6, p. 370, pl. vii, fig. 3 (2128 Alb. Mus.) (*non cet.*).
 1906. *Spirifer antarcticus*, Schwarz (pars), *ibid.*, p. 371, pl. vii, fig. 1 (134 Alb. Mus.).
 1913. *Spirifer kayserianus* Clarke, "Foss. devon. Parana," p. 252, pl. xix, figs. 1-15.
 1913. *Spirifer arrectus* Kozłowski (pars), "Faune dev. Brésil," Ann. Paléont., vol. viii, p. 7, pl. ii, figs. 7, 10 (*non* 6, 8, 9).

The Brazilian shell which Clarke separated off as a distinct species under the name *Sp. kayserianus* on the strength of its ornamentation seems to be rather abundantly represented in the Bokkeveld fauna (1160, 3888, 827, 3803 S.A. Mus.) by specimens which have usually been included in *Sp. orbigny* (= *antarcticus*), but the fewer broader and more rounded ribs, becoming weaker near the cardinal angles, apart even from the ornamentation, serve to distinguish it, at any rate as a variety, though internal casts are generally difficult to identify. The ornamentation is beautifully preserved in a specimen (422 Pret. Mus.) from Boschluis Kloof in the Pretoria Museum, the fine radial lines bearing small granules at the intersections of the finer concentric lines which become coarser and lamellose near the margins of the shell. Probably some of the shells described by other authors from the South American Devonian under other names belong to this variety. A transversely expanded form is represented by two specimens (3806, 3804 S.A. Mus.) in the South African Museum from Hottentot's Kraal, Ceres, the former measuring 32 mm. in length and 75 mm. in width, with very acute cardinal angles. The specimen (11313 Brit.

* Clarke, Mem. 9, New York State Mus., pt. 1, 1908, p. 177, pl. xxxii, figs. 1-10.

Mus.) from the Warm Bokkeveld figured by Sharpe as *Sp. orbigny* (*op. cit.*, pl. xxvi, fig. 1) is probably referable to this variety, and so may be several of the shells from the Falkland Islands which Newton * figures as *Sp. antarcticus*. It seems as if the shell from the Moose River Sandstone, Maine, which Clarke † described as *Sp. primaevus* Stein, var. *atlantica*, is closely allied to this southern form, as Clarke himself remarks.

Spirifer Ceres, Reed.

1903. *Spirifer Ceres* Reed (pars), Ann. S. Afr. Mus., vol. iv, pt. 3, p. 184, pl. xxii, fig. 7 (144 S.A. Mus.), pl. xxiii, fig. 1. (148 Cape Mus.), *non* pl. xxii, fig. 6 (145 S.A. Mus.).
 ? 1903. *Spirifer (Reticularia ?)* sp. Reed, *ibid.*, p. 185, pl. xxiii, fig. 4 (139 S.A. Mus.).
 1905. *Spirifer antarcticus* Thomas (pars), Zeitschr. deut. geol. Gesell., vol. lvii, p. 261, t. xiii, fig. 25 (*non cet.*).
 1906. *Spirifer ceres* Schwarz, Rec. Albany Mus., vol. i, pt. 6, p. 375, pl. vii, fig. 6 (49 Alb. Mus.).
 1908. *Spirifer arrectus* var. *Hawkinsi* Knod, Neues Jahrb. f. Miner. Geol., Beil. Bd. xxv, p. 549, t. xxviii, fig. 1.
 1913. *Spirifer ceres*, Clarke, "Foss. devon. Parana," p. 232.
 1913. *Spirifer arrectus* Kozłowski (pars), "Foss. dev. Brésil," Ann. Paléont., vol. viii, p. 7, pl. ii, fig. 9 (*non cet.*).

The author's description of this species applies to the specimen (No. 144 S.A. Mus.) which he illustrated in his figure 7, having 4–6 ribs on each side of the sinus, and not precisely to that represented in his figure 6 (145 S.A. Mus.), which has more numerous ribs and other differences, so that the former must be taken as the type of the species, as Schwarz pointed out in 1906 (*op. cit.*, p. 368), though unfortunately (p. 375) he quotes all my figures under his further remarks on *Sp. Ceres*. The specimen which he figures (49 Alb. Mus.) is a good example of a brachial valve.

In 1908 Knod (*op. cit.*) considered that all the specimens which the author had referred to *Sp. Ceres* were probably identical with *Sp. Hawkinsi* Morris and Sharpe, from the Falkland Isles, and he regarded this species as a variety of *Sp. arrectus* Hall, and identical with *Sp. Quichua* D'Orb., in spite of Morris and Sharpe ‡ clearly

* Newton, Proc. Roy. Phys. Soc. Edinburgh, vol. xvi, p. 252, pl. x.

† Clarke, Mem. 9, New York State Mus., pt. 2, 1909, p. 82, pl. xix, figs. 5–12; pl. xx, figs. 6, 7.

‡ Morris and Sharpe, Proc. Geol. Soc., vol. ii, 1846, p. 276, pl. xi, figs. 1a, 1b.

stating that *Sp. Hawkinsi* had only 3 ribs on each side of the sinus, while the form to which Schwarz restricted the name *Ceres* and figured was regarded as another variety of *Sp. arrectus* and was allowed to retain the name *Ceres*. With this opinion the author cannot agree, and Clarke in 1913 (*op. cit.*) contested Knod's interpretation of the species, while he drew attention to its resemblance to *Sp. Iheringi* Kayser, a Brazilian species which Kayser established in 1900, but which Clarke * more fully described. Kozlowski (*op. cit.*) figured several shells under the name *Sp. arrectus* from Brazil, but only one resembles my *Sp. Ceres* as here restricted. The typical form comes from near Triangle (144, 149 S.A. Mus.). The broken specimen figured by me as *Reticularia* sp. shows 4-5 weak ribs on each side which are not represented in the figure, and it may probably be referred to *Sp. Ceres*.

Spirifer Ceres, Reed, var. *Iheringi* Kayser.

1900. *Spirifer Iheringi* Kayser, Rev. Mus. Paulista, vol. iv, p. 303, pl. i, fig. 2 ; pl. ii, fig. 3.
 1903. *Spirifer ceres* Reed (pars), Ann. S. Afr. Mus., vol. iv, pt. 3, pl. xxii, fig. 6 (145 S.A. Mus.) (*non* fig. 7).
 1908. *Spirifer arrectus* var. *Ceres* Knod, Neues Jahrb. f. Miner., Beil. Bd. xxv, p. 548, t. xxviii, fig. 4.
 1913. *Spirifer Iheringi*, Clarke, "Foss. devon. Parana," p. 243, pl. xx, figs. 1-15 ; pl. xxi, figs. 11-13.
 1913. *Spirifer arrectus* Kozlowski (pars), "Foss. devon. Brésil," Ann. Paléont., vol. viii, p. 7, pl. ii, figs. 6, 8.

The type of shell (No. 145 S.A. Mus.) from Slangfontein, which was figured by the author as belonging to *Sp. Ceres*, has more numerous and more angular ribs than the typical form of that species as correctly limited by Schwarz, and it seems comparable rather with *Sp. Iheringi* as described by Clarke from Brazil, though the latter seems to show a transition into the true *Sp. Ceres*. There are many specimens in the South African Museum and other collections which may be probably referred to or compared with *Sp. Iheringi* Kayser. This type of shell is especially abundant in the 1st Sandstone, east of Klein Straat Siding, and the casts show all the internal and external characters figured by Clarke (1087, 1095, 1096, 1097, S.A. Mus.). But we may doubt if this is a well-established species really separable from *Sp. Ceres*, and it may be only a variety. The whole question of the affinities

* Clarke, *op. cit.*, 1913, p. 243, pl. xx, figs. 1-15 ; pl. xxi, figs. 11-13.

or identity of the South African, South American, and North American species of *Spirifer*, and their relations to certain European Lower Devonian forms, is discussed at length by Clarke * in connection with his Brazilian material. In the latter he usually was able to distinguish the ornamentation of the shell and found it a valuable guide, whereas in the Bokkeveld collections we have almost invariably only poor casts or impressions to deal with, so that satisfactory conclusions are difficult to arrive at.

Spirifer euelpis sp. nov.

(Pl. V, fig. 1.)

? 1893. *Vitulina pustulosa* Ulrich (pars), Neues Jahrb. f. Miner. Geol., Beil. Bd. viii, t. iv, figs. 27, 29, ? 28.

1897. *Vitulina pustulosa* Kayser (pars), Zeitschr. deut. geol. Gesell., vol. xlix, p. 296, t. ix, figs. 11, 12 (*non cet.*).

1908. *Spirifer* sp. Reed, Ann. S. Afr. Mus., vol. iv, pt. 8, p. 400, pl. xlviii, fig. 4 (35 S.A. Mus.).

? 1908. *Spirifer planoconvexus* Knod, Neues Jahrb. f. Miner. Geol., Beil. Bd. xxv, p. 550, t. xxvii, figs. 10–12 (*non Spirifer planoconvexus* Shumard, 1872).

? 1913. *Spirifer planoconvexus* Clarke, "Foss. devon. Parana," p. 235.

Shell transversely triangular; cardinal angles acutely pointed at about 60°, with the anterior outline forming a continuous curve; hinge-line straight at greatest width of shell. Pedicle valve rather strongly convex; beak swollen, broad, incurved, pointed; median sinus narrow, scarcely wider than interpleural grooves; lateral lobes bearing 4–5 strong, simple, angular, or subangular prominent ribs on each side, of equal strength, straight or slightly curved back, separated by equally strong and wide angular or subangular grooves. Surface of shell ornamented with zigzag lines crossing grooves and ribs alike.

Dimensions (3820 S.A. Mus.) :—

Length	11 mm.
Width	19 mm.

Remarks.—There are two examples of the pedicle valve (3820, 3821 S.A. Mus.) of this shell in the South African Museum from Uitkomst, Ceres, as well as a brachial valve (35 S.A. Mus.) from Slangfontein which is probably attributable to it, though it was figured by me in 1908 as *Spirifer* sp. In shape and general characters this species much resembles *Sp. planoconvexus* Knod, from Bolivia, which Clarke

* Clarke, *op. cit.*, 1913, pp. 220–264.

thinks is the same as *Sp. plicatus* Weller,* from the Oriskany of New Jersey and elsewhere, though no zigzag lines on the surface are described by Knod. But we may especially compare *Sp. perlamellosus* Hall, from the Helderberg Formation of Maryland.† It seems that *Sp. Mischkei* Fuchs,‡ of the European Lower Devonian and *Sp. Mercuri* Gosselet from Lievin,§ are allied species.

We may suspect that some of the shells attributed by Ulrich and Kayser to *Vitulina pustulosa* belong to *Sp. planoconvexus* Knod, or to some allied species. Knod's name is preoccupied, though Shumard's shell is now usually referred to the genus *Ambocoelia*, and since there is some doubt as to the identity of our South African with the South American shell, we may designate it by the new name *euelpis*.

Meristella cf. *Riskowskii*, Ulrich.

(Pl. V, fig. 5.)

Shell subcircular. Pedicle valve convex, with weak longitudinal median sulcus; beak low, rounded, obtuse, incurved, with rounded umbonal shoulders. Brachial valve convex, with short median internal septum about one-third the length of the valve. Surface of valves covered with a few strong concentric growth lamellae and finer growth-lines between them.

Dimensions (H. 64 Stell. Mus.): Length, *c.* 26 mm.; Width, *c.* 28 mm.

Remarks.—There is one crushed specimen (H. 64) in the Stellenbosch Museum in rather a poor state of preservation, but showing both valves as internal casts with their external impressions which may probably be referred to the Bolivian shell *Meristella Riskowski* Ulrich.|| The specimen was found at Black's Farm, De Doorns, and it is the only Bokkeveld representative of this genus and species which I have seen. In the Lower Devonian of North America *M. champlaini* Clarke ¶ and *M. lata* Hall ** are allied species.

* Clarke, Mem. 9, New York State Mus., pt. 2, 1909, p. 181, pl. xxxi, figs. 1–17.

† Schuchert and Maynard, Maryland Geol. Surv., Lower Devonian, 1913, p. 397, pl. lxix, figs. 4–6.

‡ Dahmer, Jahrb. k. preuss. geol. Landesanst., Bd. 42, 1921, p. 280, t. ix, figs. 12–14.

§ Barrois and others, Mem. Soc. Geol. Nord, vol. vi, pt. 2, fasc. 2, 1920, p. 89, pl. xiii, fig. 11; pl. xvii, figs. 22–24.

|| Ulrich, Neues Jahrb. f. Miner., Beil. Bd. viii, 1893, p. 64, t. iv, figs. 18a–c, 17, 18; Knod, *ibid.*, Beil. Bd. xxv, 1908, p. 351, t. xxviii, figs. 8, 8a.

¶ Clarke, Mem. 9, New York State Mus., pt. 1, 1908, p. 175, pl. xxx, figs. 1–20.

** *Ibid.*, p. 177, pl. xxx, figs. 21–26.

Cryptonella Baini (Sharpe).

1903. *Cryptonella Baini* Reed, Ann. S. Afr. Mus., vol. iv, pt. 3, p. 179, pl. xxii, figs. 1, 2 (133, 134 S.A. Mus.).
1908. *Cryptonella Baini* Knod, Neues Jahrb. f. Miner., Beil. Bd. xxv, p. 558.
1913. *Cryptonella?* *Baini* Clarke, "Foss. devon. Parana," p. 208, pl. xvii, figs. 10-17.

The original specimens from the Warm Bokkeveld (Nos. 11324) are in the British Museum, and those which I figured in 1903 came from Laken Vlei, Ceres, where it is common. It is an abundant form in some other localities, and Clarke records it from Brazil, but doubts its reference to the genus *Cryptonella*, and suggests that it belongs to *Oriskania*. We may remark on its resemblance to the Lower Coblenzian *Dielsma rhenana* Drev.,* which its founder considered to be most closely allied to *Terebratula melonica* Barrande, now referred to the genus *Cryptonella*. The brachidium is still unknown. I have collected good examples from the roadside cutting north of De Doorns (135 S.A. Mus.), and have seen others from the Gydo Pass (477 S.A. Mus.), Koudeveld Berg, Geelbosch Laagte, and elsewhere (6704, 3930 S.A. Mus.).

Centronella cf. *derbyana* (Hartt).

1903. *Cryptonella* sp. ? Reed, Ann. S. Afr. Mus., vol. iv, pt. 3, p. 180, pl. xxii, fig. 3 (132 S.A. Mus.).

The small subcarinate oval shell which was referred by me as perhaps a young individual of *Cryptonella Baini* must be separated from that species on account of its more elongated shape and subcarinate pedicle valve. We may probably compare it with *Terebratula derbyana* Hartt † from Brazil, and *Centronella glansfagea* Hall ‡ from the Oriskany. *Oriskania navicella* Hall and Clarke § bears a considerable resemblance. *Centronella Arcei* Ulr. || from Bolivia is less like our shell. There are examples of this Bokkeveld shell from

* Drevermann, "Fauna d. Untercoblenzschicht. von Oberstadtfeld," Palaeontographica, vol. xlix, pt. 2, 1902, p. 98, t. xii, figs. 7-10.

† Hartt and Rathbun, Bull. Buffalo Nat. Hist. Soc., vol. i, 1874, p. 236, pl. x, figs. 15, 17, 18-22, 24, 25.

‡ Clarke, Mem. 9, New York State Mus., pt. 1, 1908, p. 163, pl. xxv, figs. 1-4.

§ Hall and Clarke, Palaeont. New York, vol. viii, Brach. ii, 1894, p. 269, pl. lxxix, figs. 25-27, text-figs. 181-183.

|| Ulrich, Neues Jahrb. f. Miner. Geol., Beil. Bd. viii, 1893, p. 53, t. v, figs. 5-9.

Stinkfontein (424 Pret. Mus.) and Bavian's Kloof (467 Pret. Mus.) in the Pretoria Museum.

Leptocoelia flabellites (Conrad).

1903. *Leptocoelia flabellites* Reed, Ann. S. Afr. Mus., vol. iv, pt. 3, p. 189, pl. xxiii, fig. 10 (for earlier references).
 1905. *Leptocoelia flabellites* Thomas, Zeitschr. deut. geol. Gesell., vol. lvii, p. 264, t. xiv, fig. 35.
 1908. *Leptocoelia flabellites*, Knod, Neues Jahrb. f. Miner., Beil. Bd. xxv, p. 553.
 1913. *Leptocoelia flabellites*, Clarke, "Foss. devon. Parana," p. 269, pl. xxii, figs. 13-32.
 1913. *Leptocoelia flabellites* Kozłowski, Ann. Paléont., vol. viii, p. 9, pl. xii, figs. 1, 2.
 1916. *Leptocoelia flabellites*, Williams and Breger, Prof. Paper 89 U.S. Geol. Surv., p. 120, pl. v, figs. 19-30.

This very abundant and variable species occurs in every collection, but, owing to different conditions of preservation, it is not always easy to identify, and local varieties seem to exist.

The original specimens from the Bokkeveld, called by Sharpe *Orthis palmata* Morris and Sharpe, are from the Cold Bokkeveld (11319, 11320, 11321 Brit. Mus.). It is probable that the so-called *Leptocoelia acutiplicata* (Conrad) which has been recorded from the Devonian of South America,* but is typically a North American species,† should be included under this name, and many of the South African specimens here referred to *L. flabellites* seem indistinguishable from those figured by Thomas‡ from Argentina as *L. acutiplicata*, and the one from the Andes figured by Douglas§ as belonging to the same species. Clarke|| however, will not allow that these South American shells belong to Conrad's species or genus, and he removes them to the genus *Atrypina*.

The small subcircular shells figured by Morris and Sharpe¶ from the Falkland Islands as *Atrypa palmata*, and described as having 15-16 ribs, appear to agree completely with the Oriskany type of

* Knod, *op. cit.*, 1908, p. 553, t. xxvii, figs. 13, 14, and references.

† Kindle, Bull. 508, U.S. Geol. Surv., 1912, p. 84, pl. vi, figs. 1-15 and references.

‡ Thomas, *op. cit.*, 1905, p. 263, t. xiv, figs. 36, 37.

§ Douglas, Quart. Journ. Geol. Soc., vol. lxx, 1914, p. 39, pl. viii, fig. 4.

|| Clarke, *op. cit.*, 1913, p. 348.

¶ Morris and Sharpe, Quart. Journ. Geol. Soc., vol. ii, 1846, p. 276, pl. x, figs. 3a-d.

L. flabellites (Conr.)* and with certain of the Bokkeveld specimens (248, 249 Cape Univ.); the shape and relatively larger teeth, and cardinal process and more numerous ribs, distinguish them from the transversely subquadrate or semi-elliptical shells with fewer (8–12) ribs (*e.g.* 3923 S.A. Mus.) which correspond with *Orthis aymara* Salter † from Bolivia. In spite of most authors regarding them as synonyms, it is probable that they mark distinct varieties, if not species. The references to the synonymy prior to 1903 were given by the author in his paper of that year, and consequently are not here repeated, though only accepted with the foregoing reservations.

Coelospira conjungens sp. nov.

(Pl. IV, fig. 14.)

Shell transversely semi-elliptical; cardinal angles rounded; hinge-line straight, slightly less than width of shell. Pedicle valve gently convex; beak small, pointed, slightly elevated; surface of valve with a rather broader median rib and 4–6 nearly straight, simple, broad, low, subangular ribs on each side, successively decreasing in prominence and strength to the cardinal angles, and separated by interspaces as wide as the ribs. Dental plates short, thin. Shell coarsely and densely punctate.

Dimensions (3895 S.A. Mus.) :—

Length	10 mm.
Width	13 mm.

Remarks.—This species is based on one good internal cast of a pedicle valve (3895 S.A. Mus.) from Hottentot's Kraal, Ceres. At first sight it might seem to be referable to the variable *Leptocoelia flabellites*, but the ribs are not angular, the shell is not subcircular, and the whole appearance is dissimilar. It appears to belong to the genus *Coelospira*, and to be allied to *C. concava* Hall, and especially to *C. camilla* Hall, ‡ of the Oriskany and Upper Helderberg, which Schuchert § puts in the genus *Anoplotheca*, to which genus he refers all American species of *Leptocoelia* and *Coelospira*. Williams and Breger, || however, separate the three genera.

* Hall and Clarke, Palaeont. New York, vol. viii, Brach. ii, 1894, p. 136, pl. liii, figs. 40–46, 53.

† Salter, Quart. Journ. Geol. Soc., vol. xvii, 1861, p. 68, pl. iv, fig. 14.

‡ Hall, Palaeont. New York, vol. iv, 1867, p. 329, pl. lii, figs. 13–19.

§ Schuchert, Bull. 87, U.S. Geol. Surv., 1897, p. 144.

|| Williams and Breger, Prof. Paper 89, U.S. Geol. Surv., 1916, p. 119.

Vitulina pustulosa Hall ?

1903. *Vitulina pustulosa* Reed, Ann. S. Afr. Mus., vol. iv, pt. 3, p. 191, pl. xxiii, fig. 11 (131 S.A. Mus.) (for earlier references).
 1905. *Vitulina pustulosa* Thomas, Zeitschr. deut. geol. Gesell., vol. lvii, p. 267, t. xiv, fig. 43.
 1907. *Vitulina pustulosa* ? "Courty, Explor. Géol. Amér. Sud," Mission Scient. G. de Crequi Montfort, Paris, pl. vi, figs. 11, 12.
 1908. *Vitulina pustulosa*, Knod, Neues Jahrb. f. Miner., Beil. Bd. xxv, p. 554, t. xxvii, fig. 15.
 1913. *Vitulina pustulosa*, Kozłowski, Ann. Paléont., vol. viii, p. 8.
 1923. *Vitulina pustulosa* Kozłowski, *ibid.*, vol. xii, p. 96, pl. ix, figs. 26, 27.

Clarke * considers that the Argentine shells described by Thomas (*op. cit.*) as *Vit. pustulosa* are dorsal valves of *Atrypina*, and that most of Kayser's specimens figured in 1897 from the same country are small specimens of *Lepto. flabellites*. No true examples of *Vit. pustulosa* in South America had been observed by Clarke when he published his Brazilian memoir in 1913, and he also stated that my Bokkeveld shell was certainly not a *Vitulina*, and he held the same view with regard to Knod's Bolivian specimens. Whether such a sweeping statement is justified may be questioned, but at any rate some of Ulrich's † and of Kayser's ‡ figured specimens from Bolivia and Argentina respectively seem indistinguishable from the shell in the Bokkeveld Beds described by me above as *Spirifer euelpis*.

Ambocoelia pseudo-umbonata, Kozłowski.

1903. *Ambocoelia umbonata* Reed, Ann. S. Afr. Mus., vol. iv, pt. 3, p. 186, pl. xxiii, fig. 5 (130 S.A. Mus.).
 1908. *Ambocoelia umbonata* Knod, Neues Jahrb. f. Miner., Beil. Bd. xxv, p. 551.
 1913. *Ambocoelia pseudo-umbonata* Kozłowski, Ann. de Paléont., vol. xii, p. 95, pl. ix, figs. 1-9.

The South African shell which was described by the author in 1903 as *Ambocoelia umbonata* on the strength of two pedicle valves is found to be rather abundantly represented, and the additional specimens

* Clarke, "Foss. devon. Parana," 1913, pp. 83, 350.

† Ulrich, Neues Jahrb. f. Miner., Beil. Bd. viii, 1893, t. iv, fig. 29 (? 28).

‡ Kayser, Zeitschr. deut. geol. Gesell., vol. xlix, 1897, p. 296, t. ix, figs. 11, 12 (*non cet.*).

allow us to identify the species rather with the South American form described by Kozłowski (*op. cit.*) as *A. pseudo-umbonata* than with the typical North American form, as Kozłowski himself suspected, though it may be questioned if it should be separated only as a variety. Clarke * himself had expressed a doubt as to the identity of the two forms. But *A. umbonata* is somewhat variable.†

There is a fine large specimen (319) of a pedicle valve from the Gydo Pass in the collection of the Cape University measuring about 20 mm. in width and 12 mm. in length.

Rensselaeria montaguensis, Reed.

1908. *Rensselaeria montaguensis* Reed, Ann. S. Afr. Mus., vol. iv, pt. 8, p. 401, pl. xlviii, figs. 5, 6 (1610 S.A. Mus.) [*non* fig. 7].

1908. *Rensselaeria* aff. *Stewarti*? Reed, *ibid.*, p. 403 (30, 21a S.A. Mus.).

This species was considered by the author in 1908 to resemble *R. atlantica* Clarke ‡ from the Chapman Sandstone (Lower Devonian) of Maine, and we may here note that it is more closely allied to *R. mainensis* Williams and Breger § from the same formation. Indeed it may be identical with it. *R. Stewarti* Clarke || from the Dalhousie beds may also be compared, and it is almost certain that the specimens in the South African Museum from the Gydo Pass and Ladismith (30, 21a S.A. Mus.), and one from the Gydo Pass (82) in the Sedgwick Museum which the author regarded as probably allied to *R. Stewarti*, may be referred to *R. montaguensis*. A good internal cast of a complete shell from Uniondale (606 S.A. Mus.) in the South African Museum shows the internal characters clearly. Kegel ¶ put *R. atlantica* in the same group as *R. ovoides* Hall, to which therefore belongs the Bolivian *R. Knodi* Clarke.** But *R. falklandica* Clarke †† seems more closely allied to the Bokkeveld species.

* Clarke, "Foss. devon. Parana," 1913, pp. 76, 81.

† Kindle, Bull. 508, U.S. Geol. Surv., 1912, p. 83.

‡ Clarke, Mem. 9, New York State Mus., pt. 2, 1909, p. 79, pl. xxix, figs. 1-18.

§ Williams and Breger, Prof. Paper 89, U.S. Geol. Surv., 1916, p. 72, pt. xi, figs. 1-15.

|| Clarke, *op. cit.*, 1909, p. 38, pl. vii, figs. 10-20 (? p. 79, pl. xviii, figs. 1-3).

¶ Kegel, "Der Taunusquartzit von Katzenelnbogen," Abh. k. preuss. geol. Landesanst., N.F., Heft 76, 1913, pp. 121-139.

** Clarke, "Foss. devon. Parana," 1913, p. 268; Kozłowski, *op. cit.*, 1923, p. 91, pl. x, fig. 19.

†† Clarke, *op. cit.*, 1913, p. 267, pl. xvii, figs. 29-31.

Rensselaeria relictæ, Schwarz.

1903. *Trigeria* aff. *Gaudryi* Reed, Ann. S. Afr. Mus., vol. iv, pt. 3, p. 178, pl. xxi, figs. 11, 12 (150, 151 S.A. Mus.).
 ? 1903. *Rensselaeria* sp. *a*, Reed, *ibid.*, p. 176, pl. xxi, fig. 8 (149 S.A. Mus.).
 1906. *Rensselaeria relictæ* Schwarz, Rec. Albany Mus., vol. i, pt. 6, p. 364, pl. vii, fig. 7 (93 Alb. Mus.).

The question of the separation of *Trigeria* Bayle, from *Rensselaeria* Hall, and the taxonomic value of these groups has been discussed by Kegel,* but he has only dealt with the European and North American forms. He is led to regard *Trigeria* as only a subgenus of *Rensselaeria*, and if this is accepted we may, with much probability, refer Schwarz's species to it. *R. relictæ* was described as almost circular, but it is wider than long and the figure is not quite satisfactory. The hinge-plate is massive and thick, probably owing to age, and is bilobed anteriorly with a short median groove on it; the bases of the crura are seen on its front edge, and a low, short, thick median septum extends forwards between the rather deeply sunk, well-defined sub-triangular muscle-scars which are in contact along their shorter inner sides and embrace in front a faint semi-elliptical area longitudinally striated, probably representing the anterior adductor scars. A few large pits are present on the genital areas on each side. The number of ribs is about 30-40, and is rather more than in the shell which the author, in 1903, compared with *Trigeria gaudryi* Oehl., and the hinge-plate is more massive, but the two agree in shape and general characters and are probably referable to the same species, though Kegel (*op. cit.*, p. 138) thought my *Trig. gaudryi* might be identical with my *Renss. cf. confluentina*.

Rensselaeria rotunda Reed.

1906. *Rensselaeria* cf. *confluentina* Reed, Geol. Mag., Dec. v, vol. iii, p. 308, pl. xvi, fig. 6 (605 S.A. Mus.) (= *R. rotunda* nom. prop.).

The name *rotunda* was suggested by the author in 1906 for the specimen (605 Cape Mus.) from the Gouritz River which was compared with Fuchs' European species *R. confluentina*. The view which Kegel †

* Kegel, "Der Taunusquartzit von Katzenelnbogen," Abh. k. preuss. geol. Landesanst., N.F., Heft 76, 1913, pp. 121-139.

† Kegel, *op. cit.*, p. 138.

adopted that it might be identical with the Bokkeveld shell previously described as *Trigeria* aff. *Gaudryi* * does not seem correct, but it may be allied to *Renss. falklandica* Clarke.† A good specimen of *R. rotunda* from Stinkfontein, Ceres, has been recognised in the Pretoria Museum (449 Pret. Mus.). We may probably compare with it the coarsely ribbed *R. diania* Clarke ‡ from the Moose River Sandstone of Maine, a species which is very similar to the European *R. crassicosta* Koch.

It may be mentioned that Dienst § considers the true *R. confluentina* Fuchs to be a synonym of *Trigeria gaudryi* Oehlert.

Trigeria gydoensis nom. prop.

1903. *Rensselaeria* sp. β , Reed, Ann. S. Afr. Mus., vol. iv, pt. 3, p. 177, pl. xxi, fig. 9 (156 S.A. Mus.).

? 1903. *Retzia* cf. *Adrieni*, Reed, *ibid.*, p. 187, pl. xxiii, fig. 6 (153 S.A. Mus.), fig. 7 (138 S.A. Mus.).

? 1906. *Rensselaeria* sp. β , Schwarz, Rec. Albany Mus., vol. i, pt. 6, p. 365 (2602 Alb. Mus.).

Schwarz thought it unfortunate that this "well-marked species" had not received a name, and we may accordingly suggest the name *gydoensis*, as the original specimen (156 S.A. Mus.) came from the Gydo Pass. It is probable that the external cast (138 S.A. Mus.) from Uitkomst, figured by the author as *Retzia* cf. *Adrieni*, should also be assigned to this species. With regard to its generic position we may perhaps refer this so-called *Rensselaeria* sp. β to the genus *Trigeria*, on the strength of its resemblance in shape and external characters to *Trigeria lepida* (Hall) || from the Hamilton Group. It does not seem referable to the genus *Brazilia* Clarke, ¶ for that genus has no median sinus or fold, and at any rate we cannot see any trace of a similar loop in the interior. So far as they are known, the internal characters of our Bokkeveld shell appear to be more like *Trigeria* and *Rensselaeria* (which, as above stated, are not generically separated by Kegel). Schwarz's specimen (2602 Alb. Mus.) from Boschluis Kloof appears to be distinct from my type.

* Reed, Ann. S. Afr. Mus., vol. iv, pt. 3, 1903, p. 178, pl. xxi, figs. 11, 12.

† Clarke, *op. cit.* 1913, p. 267, pl. xvii, figs. 29-31.

‡ Clarke, Mem. 9, New York State Mus., pt. 2, 1909, p. 80, pl. xviii, figs. 4-6.

§ Dienst, Jahrb. k. preuss. geol. Landesanst., vol. xxxiv, pt. 1, 1914, p. 588.

|| Hall, Palaeont. New York, vol. iv, 1867, p. 276, pl. xlv, figs. 1-6; Hall and Clarke, *ibid.*, vol. viii, pt. 2, pl. l, figs. 36-40.

¶ Clarke, *op. cit.*, 1913, p. 214, pl. xvii, figs. 18, 19.

Scaphiocoelia africana, Reed.

1906. *Scaphiocoelia? africana* Reed, Geol. Mag., Dec. v, vol. iii, p. 306, pl. xvii, figs. 1-3a (607, 609 S.A. Mus.).
- ? 1908. *Rensselaeria montaguensis* Reed (pars), Ann. S. Afr. Mus., vol. iv, pt. 8, pl. xlviii, fig. 7 (1612 S.A. Mus.) (*non* figs. 5, 6).
1908. *Scaphiocoelia africana*, Reed, *ibid.*, p. 403, pl. xlviii, fig. 9 (1173 S.A. Mus.).

Since the author established this species in 1906 Knod* and Kozłowski† have given us considerable details of the internal characters of the closely allied form *Sc. boliviensis* Whitfield from the corresponding beds in South America. The last-mentioned author remarks that it seems closely allied to the South African species. More specimens (426 Pret. Mus.) which have been examined by me throw no further light on the characters of the species. But the generic reference can no longer be doubted. One of the shells (1612 S.A. Mus.) which was figured as *Renss. montaguensis* by the author in 1908 should apparently be placed in this species, and it is possible that the impression of a brachial valve (152 S.A. Mus.) which the author described in 1903 as *Rensselaeria* sp.?‡ from an unknown locality, having a peculiar grooving of the ribs near the beak, which has not been observed in any other specimen, may also belong to *Sc. africana*.

Scaphiocoelia africana, var. *elizabethae*, Reed.

1908. *Scaphiocoelia? africana* var. *elizabethae* Reed, Ann. S. Afr. Mus., vol. iv, pt. 8, p. 404, pl. xlviii, figs. 10-14 (1173a, 1175, 1176 S.A. Mus.).

Since this variety was described no further material has come under my notice, but Kozłowski (*op. cit.*, 1923, p. 93) remarks that it is referable to the same genus as the Bolivian species *Sc. boliviensis*, and, like *Sc. africana*, seems allied to it. Knod's figure of the interior of the brachial valve of this South American species (Knod, *op. cit.*, 1908, pl. xxix, fig. 4) seems to agree closely with the characters seen in our specimens.

Derbyina hottentot (Schwarz).

1906. *Rensselaeria hottentot* Schwarz, Rec. Albany Mus., vol. i, pt. 6, p. 365, pl. vii, fig. 8 (2578 Alb. Mus.).

The specimen on which Schwarz founded this species is an internal

* Knod, Neues Jahrb. f. Miner., Beil. Bd. xxv, 1908, p. 555, t. xxix, figs. 1-5.

† Kozłowski, Ann. de Paléont., vol. xii, 1923, p. 91, pl. x, fig. 20, text-fig. 6.

‡ Reed, Ann. S. Afr. Mus., vol. iv, pt. 3, p. 178, pl. xxi, fig. 10 (152 S.A. Mus.).

(not an external) cast of a brachial valve from Hottentot's Kloof, Ceres. As he remarked, the central rib is broader than the rest and is furrowed, just as in *D. Smithi*, and there are 6-7 narrower ribs on each side. The punctation, which is an important character, is distinct, and there are fine concentric striae over the surface also. The umbonal characters are not well preserved. Schwarz's figure is hardly satisfactory, and makes the shell too oval in shape. It is undoubtedly closely allied to *D. whitiorum* var. *africana* described below, but it seems to have fewer ribs. *D. Smithi* (Derby),* from the Brazilian Devonian, has, on the other hand, fewer and broader ribs than *D. hottentot*, and they are only distinctly developed near the margins.

Derbyina simplex (Schwarz).

1906. *Trigeria simplex*, Schwarz (pars), Rec. Albany Mus., vol. i, pt. 6, p. 366, pl. vii, fig. 9 (2589 Alb. Mus.).

1908. *Rhynchospira*? *simplex* Reed, Ann. S. Afr. Mus., vol. iv, pt. 8, p. 400.

This species was founded on the internal cast of a brachial valve (2589 Alb. Mus.) from the Gydo Pass; it is transversely subcircular in shape, with a short median fold arising at about one-third the length of the shell from the beak, and having a more prominent narrower rib on each side of it than the other 7-8 low rounded lateral ones, which are themselves narrower than the median one, and successively decrease in size. There are 15-17 ribs in all, not 21 as Schwarz described.

The shells from Montagu (79 Alb. Mus.) which he ascribed to this species show certain differences which incline me to remove them from association with it, but the form is too imperfectly known for a satisfactory determination. Some similar shells from the Steytlerville district occur on a slab (105) in the Port Elizabeth Museum.

The relations of *D. simplex* seem to be with *D. Smithi* and *D. hottentot* rather than with my *Trigeria* cf. *Gaudryi*, as Schwarz believed. For the latter shell may be referred without much doubt to Schwarz's *Rensselaeria relicta*.

Derbyina variegata (Reed).

1906. *Ptychospira variegata* Reed, Geol. Mag., Dec. v, vol. iii, p. 309, pl. xvi, fig. 7 (788 S.A. Mus.).

The specimen which the author described in 1906 as *Ptychospira*

* Clarke, *op. cit.*, 1913, p. 217, pl. xvii, figs. 20, 26.

variegata must be referred to the genus *Derbyina*, and it closely resembles *D. Smithi*, except in the number and size of the ribs, which are broader and number only 3-5 on each side of the median one. The locality, Hottentot's Kraal, has yielded a considerable number of specimens (3889, 3895 S.A. Mus.) (400 Pret. Mus.), but the locality of the type is unknown. We may remark on its close similarity in shape and ribbing to *Coelospira? colona* Clarke * from Brazil, but the latter is described as possessing no punctae which are conspicuous in *D. variegata*, and Clarke himself (*op. cit.*, p. 82) has expressed the opinion that the latter is probably congeneric with *D. Smithi* (Derby).

Derbyina whitiorum, Clarke, var. nov. *africana*.

(Pl. V, figs. 2, 3.)

? 1903. *Rhynchospira* cf. *Silveti* (Ulrich) Reed, Ann. S. Afr. Mus., vol. iv, pt. 3, p. 188, pl. xxiii, fig. 8 (153 S.A. Mus.).

Shell plano-convex to bi-convex, subcircular. Pedicle valve moderately convex, subcarinate; beak moderate, pointed, incurved; surface of valve covered with 16-20 low, rounded, simple ribs, 8-10 being placed on each side of a narrow median sulcus, successively decreasing in size and strength to the cardinal angles, and separated by grooves narrower than the median sulcus; dental plates thin, short, subparallel, with short muscle-scars lying between them. Brachial valve subcircular, gently convex or flattened; surface with 8-10 similar ribs on each side of a rather broader median one, occasionally somewhat sunken. Internal median septum present, extending about two-fifths the length of the valve. Shell densely punctate.

Dimensions (3884 S.A. Mus.) :—

Length of pedicle valve	.	.	11.0 mm.
Width	„	„	11.5 „

Remarks.—This small species is rather abundant in the coarse sandstone of Hottentot's Kraal, Ceres (3884, 3389, 3808, 3890, 3891 S.A. Mus.) (458, 421, 436, 434 Pret. Mus.), and occurs at Ezelfontein, Ceres (48 Cape Univ.), but is rarely well preserved. One pedicle valve (3884) and one brachial valve (3389) show the ribbing distinctly, but the surface is generally worn and the ribs are faint. It is very closely allied to *D. whitiorum* Clarke † from Brazil, but the pedicle valve of our variety seems more subcarinate.

* Clarke, *op. cit.*, 1913, p. 275, pl. xxii, figs. 8-12.

† *Ibid.*, p. 218, pl. xxii, figs. 1-7.

There is in the British Museum the best preserved internal cast of a brachial valve of this shell (B. 45500) which I have seen; it is labelled "*Atrypa* sp., Gydow Pass," and it seems to have belonged to the original Bain collection. It shows all the characteristic features of our species with considerable distinctness. It is probable that the small shell (153 S.A. Mus.) from Gydo Pass, Ceres, which the author in 1903 compared with Ulrich's *Rhynchospira* [*Centronella*] *Silveti*, may also be referred to this variety of *D. whitiorum*. The indistinct fossil (96 S.A. Mus.) from Gamka Poort, which the author * believed was a lamellibranch, and doubtfully referred to *Praeccardium*, seems to be a distorted specimen of a *Derbyina* of much the same character.

Some of the Bokkeveld specimens here included, especially those from Klein Straat Siding (1084, 1089 S.A. Mus.), seem particularly to resemble *Retzia wardiana* Hartt and Rathbun,† and so does the shell figured by Schwarz‡ as *Trigeria Silveti* (Ulr.), but they are not well enough preserved for exact determination; and the median sulcus on the pedicle valve seems no larger or deeper than the grooves between the lateral ribs.

Rhynchonella (Clarkeia) Bodenbenderi (Kayser).

(Pl. IV, fig. 6.)

1897. *Liorhynchus Bodenbenderi*, Kayser, Zeitschr. deut. geol. Gesell., Bd. xlix, p. 292, t. viii, figs. 1-10.
 1905. *Liorhynchus Bodenbenderi*, Thomas (pars), *ibid.*, Bd. lvii, p. 265, t. xiv, figs. 31, 32 (*non* figs. 33, 34).
 1913. *Liorhynchus* [*Clintonella*] *Bodenbenderi* Clarke, "Foss. devon. Parana," pp. 341-345, text-figs. 1-5.
 1923. *Clarkeia antisiensis* Kozłowski, "Faune Dev. Bolivie," Ann. Paléont., vol. xii, p. 86, pl. ix, figs. 18-23, text-fig. 5 (1-4).

One internal cast of the brachial valve of a rhynchonelloid shell with a less perfect impression of its exterior was collected by me at Ezelfontein, and it agrees well with specimens of *Liorhynchus Bodenbenderi* as figured by Kayser and Thomas from the Argentine Devonian. The valve in our specimen is suboval in shape, but rather longer than wide, flattened in the middle, but descending steeply on the postero-

* Reed, Ann. S. Afr. Mus., vol. iv, pt. 6, 1904, p. 255, pl. xxxi, fig. 7.

† Hartt and Rathbun, Bull. Buffalo Nat. Hist. Soc., vol. i, 1874, p. 245, pl. x, figs. 2-5, 8, 9, 11, 12, 14.

‡ Schwarz, Rec. Alb. Mus., vol. i, pt. 6, 1906, p. 367, pl. vii, figs. 10a-c (2127 Alb. Mus.).

lateral margins; the centre of the valve is occupied by a group of 4 equally strong, angular, straight ribs, extending from the beak to the margin, and forming a flattened low fold which is only definitely elevated at its front end; the 2 middle ribs of the 4 are straight and parallel; on each side of this group are 6 rather smaller, but similar, ribs, curving slightly outwards and forming the lateral lobes of the shell, but the 5th rib is weak and the 6th nearly obsolete. A median septum extends internally for half the length of the valve, arising from the hinge-plate where there is also a peculiar cardinal process (not well preserved); the crura are rather long and diverge at an angle of about 45° from the median line. The surface of the shell seems to be finely granulated. Clarke (*op. cit.*) considered that *L. Bodenbenderi* could be safely placed in the Silurian genus *Clintonella*, but Kozłowski identifies the species with *Terebratula antisimensis* D'Orb., and makes a new genus, *Clarkeia*, for its reception.

Dimensions :—

Length	.	.	17 mm.
Width	.	.	16 mm.

Retzia ? *Thomasi* sp. nov.

(Pl. V, fig. 4.)

? 1903. *Rhynchospira* cf. *Silveti* Reed (pars), Ann. S. Afr. Mus., vol. iv, pt. 3, p. 188, pl. xxiii, fig. 9 (131 S.A. Mus.) (*non* fig. 8).

Shell subcircular. Pedicle valve gently convex, with prominent, pointed, slightly incurved beak, the umbonal edges straight, extending nearly half the length of the shell, diverging at about 80° – 90° . Surface of valve ornamented with about 18 straight, simple, rounded, or slightly subangular ribs of equal size, separated by grooves of equal or subequal width, all covered with delicate, close, concentric striae. Shell substance minutely punctate? Dental plates short, strong, diverging at small angle.

Dimensions :—

Length	.	.	11 mm.
Width	.	.	11 mm.

Remarks.—The well-preserved specimen of this shell, collected by the author from the roadside cutting, near Buffelskraal, north of De Doorns, bears a close resemblance to the figure of one * of the shells

* Thomas, Zeitschr. deut. geol. Gesell., vol. lvii, 1905, p. 265, t. xiv, fig. 33 (*non* *cel.*).

from Argentina, ascribed by Thomas to *Liorhynchus Bodenbenderi* Kayser, though it is completely different from the type, and we may well doubt its specific identity in spite of the great variability of this species. There is no sign of any median sinus or group of larger ribs, and Thomas (*op. cit.*) states that this is also the case in his young individuals of *L. Bodenbenderi*. But it is difficult to see how such a shell can develop into the coarsely ribbed elongate sinuated form of the adult, with much fewer plications and a blunt low beak to the pedicle valve. At any rate it is safer to separate our Bokkeveld shell from these dubious representatives of *L. Bodenbenderi* Kayser, and we may distinguish it by the name *Thomasi*. But it may belong to a completely different genus such as *Retzia*. Hartt and Rathbun* figure a shell from Eréré as *Stenocisma dotis* Hall, which looks rather like it, and Knod† identifies a Bolivian brachiopod with this species. The imperfect specimen (131 S.A. Mus.) which the author in 1903 figured as *Rhynchospira* cf. *Silveti* Ulr., from the Warm Bokkeveld (*op. cit.*), may well be ascribed to the same species as our De Doorns specimen.

Incertae sedis.

1. It is very doubtful if the fragmentary shell from Gamka Poort (221 S.A. Mus.) which the present author described in 1903 as *Rhynchonella* (*Camarotoechia* ?) sp.‡ was correctly assigned to this genus, and it is at any rate too poor for satisfactory determination.

2. The fragmentary brachiopod which the author figured and described as *Orthis*? sp. in 1903 § is of doubtful reference, and it is possible that the genus has been mistaken.

3. The impression of a large oval shell (6025 S.A. Mus.) from Uitenhage was figured and described by the author || in 1908 as *Rensselaeria* cf. *cayuga* Hall and Clarke, but a further examination of this unique and poor specimen confirms the occasional bifurcation and intercalation of the ribs (which are narrow and subangular), and therefore suggests that it cannot be referred to this genus in which the ribs are always simple and undivided, and we may more probably place it in some

* Hartt and Rathbun, Bull. Buffalo Soc. Nat. Hist., vol. i, 1874, p. 246, pl. viii, figs. 10, 12.

† Knod, Neues Jahrb. f. Miner. Geol., Beil. Bd. xxv, 1908, p. 552, t. xxvii, figs. 9, 9a.

‡ Reed, *op. cit.*, 1903, p. 175, pl. xxi, fig. 7.

§ Reed, *ibid.*, 1903, p. 175, pl. xxi, fig. 6.

|| *Ibid.*, vol. iv, pt. 8, 1908, p. 402, pl. xlviii, fig. 8.

genus such as *Hipparionyx*. But the specimen is in too unsatisfactory a condition for a precise comparison, and no other similar example has been observed.

4. The species *Tropidoleptus carinatus* Conrad has been recorded from South Africa * and from the corresponding beds in South America,† but the author is still doubtful of its occurrence in the Bokkeveld Beds, and Schwarz ‡ thinks that specimens of *Lept. flabellites* have been mistaken for it. In North America the species recurs on three distinct horizons in the Portage and Chemung Groups.§

LAMELLIBRANCHIATA.

Nuculites abbreviatus (Sharpe).

1856. *Cleidophorus abbreviatus*, Sharpe, Trans. Geol. Soc., ser. 2, vol. vii, p. 212, pl. xxvii, fig. 2 (11339 Brit. Mus.).
 1904. *Nuculites abbreviatus* Reed, Ann. S. Afr. Mus., vol. iv, pt. 6, p. 256 (111 S.A. Mus.).
 1904. *Nuculites* sp., Reed, *ibid.*, p. 261, pl. xxxii, fig. 3 (90 S.A. Mus.).
 1908. *Nuculites abbreviatus* Reed, Ann. S. Afr. Mus., vol. iv, pt. 8, p. 388.
 1908. *Nuculites martialis* Reed, *ibid.*, p. 389, pl. xlvii, fig. 10 (1599 S.A. Mus.) [non *N. martialis* Reed, 1904].

The type of this species (11339 Brit. Mus.) came from the Gydo Pass, but that described by me in 1904 was from Klein Straat Siding (111 S.A. Mus.), and others (1616, 1615 S.A. Mus.) have been recognised from the Zwartberg Pass. The crushed specimen (90 S.A. Mus.) from Gydo Pass to which I gave no specific name in 1904 may be referred to *N. abbreviatus*, and there are more specimens of this species from the same locality (5432, 5423 S.A. Mus.) in the South African Museum in a better state of preservation. The Zwartberg specimens show the teeth with distinctness; the anterior teeth are thinner than the posterior ones, which are numerous and may number as many as 32. The shell from the Zwartberg Pass (1599 S.A. Mus.) which the author in 1908 figured as an example of *N. martialis* must be regarded as referable to *N. abbreviatus*, the curvature of the clavicular ridge and non-inflation of the shell agreeing with the last-mentioned species.

* Reed, Ann. S. Afr. Mus., vol. iv, pt. 3, 1903, p. 193.

† Kozłowski, "Faune Devon. Boliv.," Ann. Paléont., vol. xii, 1923, p. 85, pl. ix, fig. 28.

‡ Schwarz, Rec. Alb. Mus., vol. i, pt. 6, 1901, p. 367.

§ Williams, Prof. Paper 79, U.S. Geol. Surv. (1913).

referred to this species, but no internal characters are visible in the solitary type specimen.

Nuculites capensis, Reed.

1904. *Nuculites capensis* Reed, Ann. S. Afr. Mus., vol. iv, pt. 6, p. 259, pl. xxxi, figs. 9, 9a (93 S.A. Mus.).
 1908. *Nuculites capensis* Knod, Neues Jahrb. f. Miner., Beil. Bd. xxv, p. 525, t. xxiv, fig. 11.

The difference between this species from Gamka Poort and *N. oblongatus* Conr. has been pointed out by the author. The obliquity of the clavicular ridge does not seem due to distortion. Knod (*op. cit.*) has recognised *N. capensis* in the Devonian of Bolivia.

Nuculites obtusus, Reed.

1904. *Nuculites Branneri* Reed, Ann. S. Afr. Mus., vol. iv, pt. 6, p. 257, pl. xxxi, figs. 8, 8a (97 S.A. Mus.).
 1908. *Nuculites Branneri* var. *obtusa*, Reed, *ibid.*, vol. iv, pt. 8, p. 389.
 ? 1913. *Nuculites pacatus* Clarke (pars), "Foss. devon. Parana," p. 179, pl. x, figs. 20-23 (*non* fig. 19).
 ? 1923. *Nuculites pacatus* Kozłowski, Ann. Paléont., vol. xii, p. 78, pl. viii, figs. 1, 1a, 2-4.

Clarke (*op. cit.*, 1913) does not think that the South African shell from Gamka Poort, which I described as *N. Branneri* Clarke, is the same as the Amazonas shell on which the species was founded, but he is certainly mistaken in associating it with my *N. pacatus*. Most of the shells from Brazil which he figures under the latter name seem to belong to the same species as the Bokkeveld one which I called *N. Branneri* in 1904; but subsequently, in 1908, I pointed out that it had an oblong rather than subelliptical shape, with a broader, more obtuse, and subtruncate posterior end, a less obliquely sloping dorsal margin, and a stouter clavicular ridge. For these reasons I removed it into a variety which I termed *obtusa*. Probably we may regard it as a definite species, for it seems to differ sufficiently from *N. Branneri* and to be a widely spread common form. Knod* recognised the species *N. Branneri* in the Devonian of Bolivia, but gave no figure. Williams and Breger† consider that *N. Branneri* is much like their *Cleidophorus perovalis* from the Chapman Sandstone of Maine.

* Knod, Neues Jahrb. f. Miner., Beil. Bd. xxv, 1908, p. 524.

† Williams and Breger, *op. cit.*, p. 161, pl. xxv, figs. 2, 10.

Nuculites oblongatus, Conrad.

(Pl. V, fig. 6.)

1923. *Nuculites oblongatus* Kozłowski, Ann. Paléont., vol. xii, p. 77, pl. viii, figs. 5a, b (and references).

This species has been described by Kozłowski from the Devonian of Bolivia, and it is represented in the Bokkeveld Beds by a specimen (1623 S.A. Mus.) from the Zwartberg Pass. It is chiefly distinguishable from *N. capensis* Reed by its vertical clavicular ridge and the shorter length of the shell. Beushausen * considers that the European species *N. [Cucullella] ellipticus* Maurer, from the Lower Devonian of Germany, is quite closely allied to *N. oblongatus*.

Our specimen (1623) shows well the group of longer teeth under the beak at the upper end of the clavicular ridge, and the much longer series of smaller posterior teeth extending nearly to the posterior end. There is another good example of this species from Ezelfontein in the Sedgwick Museum.

Nuculites martialis, Reed.

1904. *Nuculites martialis* Reed, Ann. S. Afr. Mus., vol. iv, pt. 6, p. 260, pl. xxxii, fig. 2 (103 S.A. Mus.).
Non 1908. *Nuculites martialis* Reed, *ibid.*, vol. iv, pt. 8, p. 389, pl. xlvii, fig. 10.

Though this species seems to present distinctive characters, I am rather doubtful if it is well established, for the type shell from Ezelfontein is somewhat broken, and I have not seen any other examples which can be referred to the same species, while the shell from the Zwartberg Pass (1599 S.A. Mus.) described under this name in 1908 must be considered referable to *N. abbreviatus* (see page 68).

Nuculites pacatus, Reed.

1908. *Nuculites pacatus*, Reed, Ann. S. Afr. Mus., vol. iv, pt. 8, p. 390, pl. xlvii, figs. 5, 5a, 6 (794 S.A. Mus. and 12 Vict. Coll.).
1913. *Nuculites pacatus* Clarke (pars), "Foss. devon. Parana," p. 179, pl. x, fig. 19 (non figs. 20-23).

The points of difference between *N. pacatus* and the South African shells referred to *N. Branneri* by me in 1904 were mentioned when the species was described, but it may be re-stated that *N. pacatus* differs

* Beushausen, Abh. k. preuss. geol. Landesanst., N.F., Heft 17, 1895, p. 105, t. v, figs. 9-15.

from *N. Branneri* by its more elongated oval shape, more inflated valves, more subequal and less truncate ends, lower beaks, stronger, thicker, and shorter clavicular ridge, and less oblique dorsal margin. Clarke * and Kozłowski † put both these South African types of shells under the specific name *pacatus*, and as such describe examples from the Devonian of Brazil and Bolivia. But I cannot agree that they should be combined under one specific name, and an examination of further Bokkeveld specimens shows that the above-mentioned points of difference are constant, though in imperfectly preserved shells they may not all be invariably recognisable. It does not seem that any of Kozłowski's figured shells are referable to *N. pacatus* sens. str., and the same applies to all but one of Clarke's Brazilian specimens.

A fine example of *N. pacatus* was collected by the author at Ezelfontein showing the dentition and all the typical characters of the species.

Nuculites Sharpei, Reed.

1908. *Nuculites Sharpei* Reed, Ann. S. Afr. Mus., vol. iv, pt. 8, p. 391, pl. xlvii, figs. 7, 8 (18, 19 S.A. Mus.).

1913. *Nuculites Sharpei* Clarke, "Foss. devon. Parana," p. 181, pl. x, figs. 7, 8 (*non* figs. 9-14).

This species was established for a well-defined type of shell in the Bokkeveld Beds from Ezelfontein, Ceres, and it seems to be represented in Brazil, but, judging from Clarke's figures, not all his specimens which he represents can be attributed strictly to it, for they are too short and oval; these I would remove into a new variety (see below).

Nuculites Sharpei, Reed, var. nov. *remota*.

(Pl. V, fig. 7.)

1908. *Nuculites Branneri*, Reed (pars), Ann. S. Afr. Mus., vol. iv, pt. 8, p. 389 (796, 797 S.A. Mus.).

1913. *Nuculites Sharpei* Clarke (pars), "Foss. devon. Parana," p. 181, pl. x, figs. 9, 10, 13, 14 ? (*non* figs. 7, 8).

Shell elongate-oval, narrowing posteriorly; beak obtuse, situated at one-fourth length of valve; anterior end broadly rounded, short; posterior end sharply rounded, narrower; hinge-line straight, with a series of 20-25 postumbonal very small transverse teeth reaching

* Clarke, *op. cit.*, 1913, p. 179.

† Kozłowski, Ann. Paléont., vol. xii, 1923, p. 78, pl. viii, figs. 1, 1a, 2-4.

about three-fourths its length, and 8-9 longer subumbonal teeth at top of clavicular ridge, which is long, vertical, and extending nearly three-fourths the height of shell. Surface of valve very slightly convex.

Dimensions (796 S.A. Mus.) :—

Length	.	.	35 mm.
Height	.	.	24 mm.

Remarks.—This variety is less elongate than the typical *N. Sharpei*, and some examples from an unknown locality were erroneously ascribed to *N. Branneri* by the author in 1908, but were not figured. In the collection of the University of Cape Town there is a cast and impression of a left valve (129 *a, b*) which may be attributed to this variety, but it has four strong regular equidistant growth-ridges on the surface as Clarke represents (*op. cit.*, fig. 9) in one of his specimens of *N. Sharpei* from Ponta Grossa, though such ridges are not commonly developed in the species; the inferior margin is also more strongly arched than usual. The specimen measures 34 mm. in length and about 23 mm. in height, but the beak is broken off.

Nuculites (Ditichia) colonicus Reed.

1904. *Nuculites colonicus* Reed, Ann. S. Afr. Mus., vol. iv, pt. 6, p. 259, pl. xxxii, fig. 1 (69 S.A. Mus.).

The presence of two internal septa in the valve in this species suggests that it should be referred to the genus or subgenus *Ditichia*, Sandberger, 1891,* and it appears to be allied to *Nuculites (Ditichia) doto* Clarke † of the Oriskany fauna of Highland Mills, Orange Co., New York.

Palaeoneilo antiqua (Sharpe).

1856. *Solenella antiqua* Sharpe, Trans. Geol. Soc., ser. 2, vol. vii, p. 210, pl. xxvii, fig. 1 (52056, I. 14848, 14849 Brit. Mus.).

1904. *Palaeoneilo antiqua* Reed, Ann. S. Afr. Mus., vol. iv, pt. 6, p. 261.

It is not probable that Clarke's *Pal. magnifica* ‡ from Brazil is identical with Sharpe's species, for the dentition is different, but my

* Sandberger, Neues Jahrb. f. Miner. Geol., 1891, vol. ii, p. 104; Williams and Breger, Prof. Paper 89, U.S. Geol. Surv., 1916, p. 168.

† Clarke, Mem. 9, New York State Mus., pt. 2, 1909, p. 140, pl. xxxiii, figs. 5-10.

‡ Clarke, *op. cit.*, 1913, p. 176, pl. xii, figs. 9-12.

Pal. subantiqua is closely allied, and both may be specifically inseparable from *Pal. sancti-crucis* Clarke,* but the latter varies much in shape, judging from Clarke's figures.

Williams and Breger † restrict the use of the name *Palaeoneilo* Hall to forms of the type of *P. constricta* (Conrad), using the name *Tellinites* McCoy for such species as *P. Orbignyi* and *P. Boyesi*. But the present author prefers to follow the usage of Clarke (*op. cit.*).

Palaeoneilo arcuata (Schwarz).

1906. *Palaeoneilo arcuata*, Schwarz, Rec. Albany Mus., vol. i, pt. 6, p. 378, pl. viii, fig. 5 (103 Alb. Mus.).

? 1913. *Palaeoneilo sancti-crucis* Clarke (pars) "Foss. devon. Parana," p. 177, pl. xi, fig. 14 (*non cet.*).

This species is much like the elongated example of *Pal. sancti-crucis* Clarke as figured by him from Brazil, though the umbonal ridge which usually causes the angulation of the posterior margin in that species is hardly noticeable in that example, and cannot be called strong. The more oval elongated almond shape is characteristic of *P. arcuata*. The original example of this species was collected at Hottentot's Kloof, Ceres, and there is another specimen (3866 S.A. Mus.) from this locality in the South African Museum. Schwarz believed that this species might eventually be found referable to the genus *Leda* [= *Nuculana*], but no evidence of this is available.

Palaeoneilo rudis (Sharpe).

1856. *Solenella rudis* Sharpe, Trans. Geol. Soc., ser. 2, vol. vii, p. 211, pl. xxvii, fig. 6 (11341 Brit. Mus.).

1904. *Palaeoneilo rudis* Reed, Ann. S. Afr. Mus., vol. iv, pt. 6, p. 261.

1906. *Palaeoneilo Boyesi* Schwarz, Rec. Albany Mus., vol. i, pt. 6, p. 377, pl. viii, fig. 1 (86 Alb. Mus.).

1908. *Palaeoneilo rudis* Reed, Ann. S. Afr. Mus., vol. iv, pt. 8, p. 392.

The type of this species (11341 Brit. Mus.) has the umbonal ridge less marked than Sharpe's figure (*op. cit.*) would lead us to conclude, and the umbonal sulcus is scarcely apparent. The coarse concentric ridges and lamellae are well seen. This specimen is from Hottentot's

* Clarke, *op. cit.*, 1913, p. 177, pl. xii, figs. 13-16.

† Williams and Breger, *op. cit.*, 1916, pp. 163, 168.

Kloof, and so are the other specimens (14847, 11356, 11355, 52051, 14846 Brit. Mus.) in the same collection.

The type of Schwarz's species, *P. Boyesi* (86 Alb. Mus.), is from the same locality and so is his paratype (87 Alb. Mus.), and many other specimens in the Albany Museum, while certain shells in the South African Museum (Nos. 3844, 800, 3878, 3837, 3873), likewise from the same locality, possess precisely the same features. Schwarz states that his species differs from *P. rudis* in its more prominent umbo and longer anterior portion, but an examination of his type in the Albany Museum, and of Sharpe's *P. rudis* in the British Museum, convinces me that they are inseparable, and, therefore, Schwarz's name must be dropped. Williams and Breger* compare *P. Boyesi* with *Tellinites* (*Koenenia*) *gibbosa* Goldf. var. *Kayseri* Beush. from the Chapman Sandstone, and consider the latter identical with *Pal. Orbignyi* Clarke of the Devonian of Brazil; but with this comparison the author does not agree. The European Lower Devonian shell described as *Ctenodonta unioniformis* Sandb.† appears to be more allied to *P. rudis*.

Palaeoneilo Orbignyi, Clarke.

(Pl. VI, figs. 6, 8.)

1899. *Palaeoneilo Orbignyi* Clarke, Archiv Mus. Nac. Rio de Janeiro, vol. x, p. 74, pl. viii, figs. 14-17.

In the collection of the University of Cape Town there is one large specimen of a right valve (77) of a species of *Palaeoneilo* contained in a nodule from Ezelfontein, Ceres, and differing from *P. rudis* by its more central beak and more equal anterior and posterior ends. It has been labelled *P. Boyesi* Schwarz, and is in the condition of an internal cast. The shell is transversely oval, the inferior margin being more arched than in *P. rudis*; the beak is broad and subcentral, and the whole valve is most swollen in the umbonal region. From the beak there is rather a marked low fold running down the posterior slope to the inferior margin, curving gently backwards; behind it is a flattened wide shallow sulcus with faint traces of one or two lower broader radial folds running back to the upper part of the posterior margin; and there are two similar weak folds running forwards from the beak on the upper anterior slope to the anterior margin. Behind the beak we can see about 20 short small equal transverse

* Williams and Breger, *op. cit.*, 1916, p. 165.

† Beushausen, *op. cit.*, 1895, p. 84, t. vi, figs. 10-15.

teeth forming a series extending more than half the distance to the posterior end, while between and in front of the beaks there is a shorter series of +12 smaller transverse teeth; the anterior part of the hinge is broken away.

Dimensions (77 Cape Univ.): Length, 55.0 mm.; Height, 35.0 mm.; Distance of beak from anterior end, *c.* 25.0 mm.

From a comparison of the Bokkeveld specimen with the description and figures of Clarke's *P. Orbignyi* from Brazil, there can be but little doubt that we have here to do with an example of this species. A young specimen with less marked radial folds occurs in the South African Museum from Laken Vlei, Ceres (3791 S.A. Mus.).

Palaeoneilo Orbignyi Clarke; var. nov. *tenuilineata*.

(Pl. VI, figs. 7, 7a.)

Shell transversely subelliptical; valves moderately convex, somewhat compressed posteriorly; beaks low, obtuse, rounded, situated at about two-fifths the length from the front end; narrow weak sulcus subparallel to hinge-line and close to it running back from beaks to posterior margin, and a broader more marked one below it widening to postero-inferior angle (faintly developed or absent in small examples), with occasionally traces of a third shorter weaker sulcus below. Surface of valve covered with regular fine raised concentric thread-like lines of equal strength, closely placed and equidistant, but becoming rather finer and more numerous towards the beak.

Dimensions (128 Cape Univ.):—

Length	.	.	34 mm.
Height	.	.	22 mm.

Remarks.—This variety, which is represented by specimens (128 Cape Univ.) from Keurbosch, has rather a more elongated shape than the typical *Pal. Orbignyi*, Clarke,* except in the smaller examples (132 Cape Univ.), but the beak is too subcentral for *Pal. sancti-crucis*, or for any of the other species described above. The smaller examples seem not to have the sulci developed or they are only faintly indicated. The shell from the Chapman Sandstone which Williams and Breger †

* Clarke, Archiv Mus. Nac. Rio de Janeiro, vol. x, 1899, p. 74, pl. viii, figs. 14–17; *id.*, Mem. 9, New York State Mus., pt. 2, 1909, p. 109, pl. xxviii, figs. 20–23.

† Williams and Breger, *op. cit.*, p. 165, pl. xix, figs. 3, 9, 11, 13, 15, 16; pl. xxv, figs. 1, 3, 4, 5, 12.

described as *Tellinites* (*Koenenia*) *gibbosa* Goldf. var. *Kayseri* Beush., may also be compared. The regular concentric lineation is like that in *Pal. constricta* Hall * of the Hamilton Group.

Palaeoneilo sancti-crucis, Clarke.

1904. *Palaeoneilo* cf. *fecunda* Reed, Ann. S. Afr. Mus., vol. iv, pt. 6, p. 264, pl. xxxii, fig. 6 (3965 S.A. Mus.).
 1913. *Palaeoneilo sancti-crucis* Clarke (pars) "Foss. devon. Parana," p. 177, pl. xi, figs. 13, 15 (*non* 14, 16).

According to Clarke's figures this species varies much in its shape, but, according to his description, it is "elongate, rather narrowly ovate, with subequal extremities, evenly convex, of relatively large size, suppressed umbones, a gentle double sinus on the postumbonal slope which emarginates the outline in a double curve," and he considers that my *P. subantiqua* has rather close affinities with it. But the elongate form of Clarke's species (*op. cit.*, fig. 14) is more like *P. arcuata* Schwarz, as above noticed. The shell which I compared with *P. fecunda* Hall, from Ezelfontein (3965 S.A. Mus.) appears to agree in all essentials with Clarke's fig. 13 of *P. sancti-crucis*, and some of the specimens from Hottentot's Kloof in the South African Museum may also be referable to this species. But it is difficult to separate imperfect or distorted shells of this type into species.

Palaeoneilo subantiqua, Reed.

1904. *Palaeoneilo subantiqua* Reed, Ann. S. Afr. Mus., vol. iv, pt. 6, p. 262, pl. xxxii, figs. 4, 4a (85 S.A. Mus.).
 1908. *Ctenodonta* (*Palaeoneilo*) *subantiqua* Knod, Neues Jahrb. f. Miner., Beil. Bd. xxv, p. 524, t. xxiv, fig. 10.
 ? 1913. *Palaeoneilo sancti-crucis* Clarke (pars), "Foss. devon. Parana," p. 177, pl. xi, fig. 16 (*non* 13-15).

This species seems closely similar to some of Clarke's figured examples of *P. sancti-crucis*, but the latter is typically more elongate. *P. magnifica* Clarke † is also closely related. Knod (*op. cit.*) claims to have recognised *P. subantiqua* in Bolivia, but we cannot judge of the accuracy of this identification from his figure. All the South African and South American species of this genus have close affinities,

* Hall, Palaeont. New York, vol. v, pt. 2, 1885, p. 333, pl. xlviii, figs. 1-16.

† Clarke, *op. cit.*, 1913, p. 176, pl. xi, figs. 9-12 (especially fig. 10).

and it is difficult to distinguish the species, particularly when we are ignorant of their denticulation.

Palaeoneilo vindicata sp. nov.

(Pl. VI, figs. 11, 12.)

Shell transversely suboval, narrowing posteriorly, highest at umbones. Valves moderately convex, most so anteriorly. Umbones situated at about one-fourth (or less) the length of shell, directed forwards, with depressed concave lunule below; anterior end of shell rather sharply rounded below; inferior margin rather strongly arched; posterior end of shell narrowed, blunt, rounded; dorsal edge nearly straight, slightly oblique, sloping downwards to posterior end. Teeth transverse, forming short series of about 8 in front of umbones passing into series of 6-7 narrower radially arranged teeth between umbones, and thus into posterior series of 18-20, becoming rather larger posteriorly and continued to end of hinge-line. Muscular impressions very faint.

Dimensions :—

	Left Valve.	Right Valve.
Length	12·5	17·0 mm.
Height	8·0	10·0 mm.

Remarks.—There is one good internal cast of a left valve from De Doorns, collected by Dr. Rastall, and now in the Sedgwick Museum, from which the above description is drawn up. Another specimen from the same locality in the same collection is of the right valve of a rather larger individual, and is bored by *Clionolithus priscus* (M'Coy), just as Clarke * figures in the case of a Brazilian specimen of *Pal. magnifica* Clarke. The chief distinction between our new species and the others above described is the absence of any sinus on the postumbonal slope and the non-emargination of the posterior outline. Clarke † figures a specimen from Ponta Grossa as "believed to belong" to *Pal. rhysa* Clarke, but differing considerably from the type of this species (*op. cit.*, pl. xi, fig. 5); it resembles our species to a considerable extent, and more closely than does *Pal. elliptica* Kozl.‡ from Bolivia, which, however, is allied. The European species, *Ctenodonta primaeva* Stein.,§ which Beushausen puts in *Palaeoneilo*,

* Clarke, *op. cit.*, 1913, pl. xi, fig. 11. † *Ibid.*, p. 178, pl. xi, fig. 7 (*non* 5, 6).

‡ Kozlowski, *op. cit.*, 1923, p. 79, pl. viii, figs. 6-8.

§ Beushausen, Abh. k. preuss. geol. Landesanst., N.F., Heft xvii, 1895, p. 79, t. v, figs. 28-30.

may be compared, but especially the American species *P. plana* Hall,* from the Middle Devonian of Maryland.

Ctenodonta Grahamsi, Reed.

1925. *Ctenodonta Grahamsi* Reed, Rec. Albany Mus., vol. iii, pt. 4, p. 258, pl. x, figs. 1-3.

Shell suboval, transverse, moderately biconvex, most so in middle, somewhat compressed anteriorly. Beaks large, high, incurved, slightly directed backwards, subcentrally situated, rather nearer anterior than posterior end. Inferior margin forming regular gentle convex curve bending up rather suddenly at each end; anterior end rather blunter and more subtruncate than posterior end. Preumbonal lunule short, lanceolate, not extending more than half the length of preumbonal hinge-line. Postumbonal lunule larger, sublanceolate, extending about two-thirds length of postumbonal hinge-line.

Hinge-line obtusely angulated between beaks, and bearing numerous transverse teeth, the anterior series composed of a few (7-8) broad short teeth (only 3-4 are visible), the subumbonal series of several (? 10-12) longer, sharper, more closely-placed teeth (only 4-5 are exposed) passing into the posterior series of about 10 shorter broader teeth arranged in a slightly concave curve. Posterior muscle-scar large, deeply impressed; anterior muscle-scar subcircular, smaller.

Dimensions (81 Alb. Mus.): Length, 45 mm.; Height, 34 mm.; Thickness, 23 mm.

Remarks.—There is one complete internal cast (No. 81) in the Albany Museum in the Bain Collection from the Warm Bokkeveld, and it is a unique specimen.

Knod has described and figured a shell from the Lower Devonian of Bolivia as *Ctenodonta (Palaeoneilo) musculosa*,† which appears to bear a considerable resemblance to our shell, but he uses the generic name *Palaeoneilo* in a different sense to what Clarke and the author do. The shell from Bolivia, which Ulrich termed *Nucula Krügeri*,‡ may also be compared with our species.

* Prosser and Kindle, Maryland Geol. Surv., Mid. Devon. 1913, p. 237, pl. xxvi, figs. 13-15.

† Knod, Neues Jahrb. f. Miner., etc., Beil. Bd. xxv, 1908, p. 520, t. xxiv, figs. 3-6.

‡ Ulrich, *ibid.*, Beil. Bd. viii, 1893, p. 48, t. ii, fig. 18.

Ctenodonta Stowi sp. nov.

(Pl. V, figs. 8-10a.)

1904. *Palaeoneilo* aff. *constricta* Reed, Ann. S. Afr. Mus., vol. iv, pt. 6, p. 263, pl. xxxii, figs. 5, 5a (95 S.A. Mus.).

1904. *Palaeoneilo* sp. Reed, *ibid.*, p. 264, pl. xxxii, fig. 7 (96 S.A. Mus.).

Shell subtriangular, short, rounded, somewhat inflated; beaks subanterior, situated at about one-fourth the length of the shell, with the anterior and posterior umbonal slopes meeting at 90° - 100° ; anterior end of shell steeply descending, broadly rounded at lower angle; inferior margin strongly arched, with sharply rounded narrower posterior end. Hinge-line broadly angulated, with 5-8 teeth in front, several more slender subumbonal teeth and a gently arched post-umbonal series of 12-16 coarse, stout teeth, reaching back four-fifths the length of the shell. Valves moderately convex, deepest anteriorly, and somewhat truncated in front. Surface of shell ornamented with rather strong concentric lamellae.

Dimensions (7777 S.A. Mus.):—

Length	.	.	.	14.5 mm.
Height	.	.	.	12.0 mm.

Remarks.—The two specimens (95, 96 S.A. Mus.) from Gamka Poort which were ascribed to *Palaeoneilo* by the author in 1904 were poor, but better ones (133a, 7777 S.A. Mus.) have now been examined in the South African Museum, obtained from between the 2nd and 3rd Sandstones, 300 yards from Triangle Station, and Dr. Rastall has obtained a perfect internal cast of a complete shell from De Doorns (now in the Sedgwick Museum), so that its reference to *Ctenodonta* is satisfactorily determined. It seems to be a species allied to *Ct. Maureri* Beush.* of the European Devonian, and probably to *Nucula corbuliformis* Hall† of the Hamilton Group of North America. The Brazilian species of *Nucula* described by Clarke‡ from the Devonian of Para seem less closely related.

* Beushausen, Abh. k. preuss. geol. Landesanst., Heft 17, 1895, p. 85, t. vii, figs. 11-28.

† Hall, Palaeont. New York, vol. v, pt. 2, 1885, p. 319, pl. xlvi, figs. 24-34.

‡ Clarke, Archiv Mus. Nac. Rio de Janeiro, vol. x, 1899, p. 70.

Ctenodonta? nigella (Reed).

1908. *Nucula nigella* Reed, Ann. S. Afr. Mus., vol. iv, pt. 8, p. 394, pl. xlvii, figs. 13, 13a (3946 S.A. Mus.).

It was suggested by me in 1908 that Sharpe's Bokkeveld species, *Leptodomus? ovatus*, might belong to the same species as my *Nucula nigella* from the Zwartberg Pass, but there is only the external shape of the former by which to form any conclusion as to its generic position, and a further examination of the original specimen in the British Museum inclines me rather to ascribe it to *Nuculites*, and it is above mentioned in connection with *N. Beneckeii*. However, our *N. nigella* appears to be closely allied to *N. Kayseri* Clarke,* from Para, and it may belong to the new subgenus *Nuculoidea* established by Williams and Breger † for certain Lower Devonian species from Maine.

Nuculana inornata (Sharpe).

1856. *Leda inornata* Sharpe, Trans. Geol. Soc., ser. 2, vol. vii, p. 212, pl. xxvii, fig. 5.
 1904. *Leda inornata* Reed, Ann. S. Afr. Mus., vol. iv, pt. 6, p. 255.
 1908. *Nuculana inornata* Reed, *ibid.*, vol. iv, pt. 8, p. 392.

The type of shell which Sharpe chose for this species is represented by several specimens (3845, 3968, 3865 S.A. Mus.) from the original locality, Hottentot's Kloof, and from Uitkomst (77f S.A. Mus.), in the South African Museum. But the shell which Clarke ‡ figured from Brazil under this name is not the same species, or at any rate is a distinct variety, being more like my *N. viator*,§ and this has caused some confusion. An examination of Sharpe's type specimen (11340 Brit. Mus.) in the British Museum has cleared up the uncertainty. *Leda* [*Nuculana*] *diversa* Hall, which Knod || considers as identical with Sharpe's species, has a much more rapidly tapering and more pointed posterior end, and the posterior upper margin is more concave, as is seen in Clarke's and Knod's figures.

* Clarke, *op. cit.*, 1899, p. 70, t. viii, figs. 1, 2.

† Williams and Breger, *op. cit.*, 1916, p. 173.

‡ Clarke, "Foss. devon. Parana," 1913, p. 184, pl. xi, figs. 1-4.

§ Reed, Ann. S. Afr. Mus., vol. iv, pt. 8, 1908, p. 393, pl. xlvii, figs. 11, 11a.

|| Knod, Neues Jahrb. f. Miner., Beil. Bd. xxv, 1908, p. 526, t. xxiv, fig. 1.

Nuculana viator, Reed.

1908. *Nuculana viator*, Reed, Ann. S. Afr. Mus., vol. iv, pt. 8, p. 393, pl. xlvii, figs. 11, 11a.

1913. *Nuculana inornata*, Clarke, "Foss. devon. Parana," p. 184, pl. xi, figs. 1-4.

The European species *N. securiformis* (Goldf.) * from the Coblenzian may be compared with this Bokkeveld species from the Zwartberg Pass, and it is certainly the case that the specimens from Brazil which Clarke attributed to *N. inornata* Sharpe have much more the appearance of *N. viator* owing to their shorter, more pointed posterior end, subcentral beaks, and concave posterior dorsal margin.

Leda diversa Hall, which Clarke † has figured from the Brazilian area is more closely allied with this species than with *N. inornata*, in spite of Knod holding the opposite opinion as above mentioned.

Leda sp. *a*, figured by Ulrich ‡ from Bolivia, may be identical with *N. viator*.

Nuculana? agrestis, Reed.

1908. *Nuculana agrestis*, Reed, Ann. S. Afr. Mus., vol. iv, pt. 8, p. 393, pl. xlvii, figs. 12, 12a.

No further specimens of this species have been recognised in any of the collections, and there is nothing further to add to the original description.

Modiomorpha hexensis sp. nov.

(Pl. VI, figs. 1-3.)

Shell compressed, transversely oval, slightly oblique, widening a little posteriorly; valves very shallow, flattened; beak low, sub-anterior; anterior end of shell short, rounded; posterior end obliquely truncated above, with subacute postero-inferior angle; inferior margin slightly arched, nearly straight; hinge-line about two-thirds the length of the shell, straight, or weakly arcuate. Surface of valve crossed by low subangular umbonal ridge dying out posteriorly, the portion of the valve above it flattened and inclined at an obtuse angle to the lower portion. Anterior muscle-scar large subterminal, sharply-defined behind. Ornamentation of surface consisting of regular, coarse, equal, raised thread-like concentric lines, making a

* Beushausen, Abh. k. preuss. geol. Landesanst., N.F., Heft 17, 1895, p. 59, t. iv, figs. 26-28, ? 29; Barrois, Pruvost, and Leriche, Mém. Soc. Geol. Nord, vol. vi, pt. 2, 1920, p. 130, pl. xvi, fig. 12.

† Clarke, Archiv Mus. Nac. Rio de Janeiro, vol. x, 1899, p. 78, t. viii, fig. 12.

‡ Ulrich, *op. cit.*, 1893, p. 45, t. ii, fig. 14.

sharp bend on crossing the umbonal ridge and tending to be arranged in groups of 6-8 with wide grooves between the groups.

Dimensions :—

Length c. 62 mm.

Height (max.) . . . c. 28 mm.

Remarks.—The author collected specimens of this shell from the roadside cutting north of De Doorns, and there is a good specimen also (No. 280) from Keurbosch, Hex River district, in the collection of the Cape University. As regards its affinities it may be especially compared with the first figured specimen of *Modiomorpha pimentana* Clarke,* from Brazil, and it seems that *M. odiata* Clarke,† from the Moose River Sandstone, Maine, is also closely allied to it. But the angulation of the concentric lines on crossing the umbonal ridge is sharper in our species and more like *Goniophora? cercurus* Clarke,‡ of the Oriskany of New York.

It was at first thought that this species might be attributed to the genus *Cypricardella*, and Clarke has figured a Brazilian shell as *C.? olivieria*,§ which, but for the absence or obsolescence of the oblique umbonal ridge and the less sudden bending of the concentric lines on crossing it, bears a considerable resemblance, as do also some Chemung examples of *C. bellistriata* (Conr.) figured by Hall || from New York. But in our specimens there is not the excavation of the preumbonal margin, and the beaks seem to be more anterior in position. The dentition also is unknown. Clarke himself was doubtful of the generic position of his *C.? olivieria*, and remarked on its resemblance to a certain Bolivian shell referred by Knod ¶ to *Modiomorpha cf. pimentana* (Hartt and Rathbun).

Modiomorpha lunulata (Schwarz).

1906. *Nuculites lunulata* Schwarz, Rec. Albany Mus., vol. i, pt. 6, p. 378, pl. viii, figs. 6, 6a (135 Alb. Mus.).

The shell (135 Alb. Mus.) which Schwarz described as *Nuculites*

* Clarke, Archiv Mus. Nac. Rio de Janeiro, vol. x, 1899, p. 52, t. vi, fig. 4 (non 5-9).

† Clarke, Mem. 9, New York State Mus., pt. 2, 1909, p. 74, pl. xv, figs. 14, 15 (non pl. xvi, figs. 1-5).

‡ *Ibid.*, p. 141, pl. xxxiii, figs. 18-20.

§ Clarke, "Foss. devon. Parana," 1913, p. 198, pl. xvi, figs. 10, 11.

|| Hall, Palaeont. New York, vol. v, pt. 2, 1885, p. 308, pl. lxxiv, figs. 5, 6 (non *cet.*).

¶ Knod, *op. cit.*, 1908, p. 527.

lunulata is certainly not referable to that genus, for the hinge-line shows no sign of transverse teeth, and the so-called clavicular ridge is merely the sharp posterior boundary of the anterior muscle-scar just as in the species *Modiomorpha odiata* Clarke,* from the Lower Devonian of Maine. The cardinal view which Schwarz gives (*op. cit.*, fig. 6a) shows also the characters of *Modiomorpha*, and the species may possibly be identical with *M. Helmreicheni* Clarke,† from the Devonian of Para.

Probably the largest shell of the three in the British Museum marked L. 5586, measuring about 40 mm. in length and 25 mm. in height towards its posterior end, from some unknown locality in South Africa, may be referred to the same species. It bears rather broad but low unequal and non-equidistant concentric rugae, as Schwarz shows in his figure of *M. lunulata*.

Modiomorpha montaguensis sp. nov.

(Pl. V, fig. 14.)

Shell obliquely oval, much compressed, highest posteriorly, with short straight hinge-line and obtuse posterior cardinal angle; posterior margin gently arched, obliquely descending; postero-inferior angle rather sharply rounded; inferior margin nearly straight, oblique, passing up into sharply ascending, rounded, very short anterior margin, which projects below the beak. Beaks small, low, subanterior, with low but distinct gently curved umbonal ridge running back towards postero-inferior angle, but dying out posteriorly. Surface of shell covered with concentric growth-lines, some stronger than others, and all bending rather sharply on crossing the umbonal ridge.

Dimensions (Stell. Mus.) :—

Length (oblique) c. 45 mm.

Height (at right angles to hinge-line) c. 32 mm.

Remarks.—The one specimen on which this variety is founded consists of a nearly complete shell (with the right valve best preserved) in the Stellenbosch Museum. It was collected from the road between Montagu and Triangle. It is somewhat allied to the Brazilian *M. pimentana* (Hartt and Rathb.),‡ but seems higher posteriorly,

* Clarke, Bull. 107, New York State Mus., 1907, p. 218, text-fig.; *id.*, Mem. 9, New York State Mus., pt. 2, 1909, p. 74, pl. xv, figs. 14, 15; pl. xvi, figs. 1-5.

† Clarke, Archiv Mus. Nac. Rio de Janeiro, vol. x, 1899, p. 50, t. vi, figs. 1, 2, 17.

‡ Clarke, *op. cit.*, 1899, p. 52, t. vi, figs. 4-9.

the axis being inclined at a larger angle (about 45°) to the hinge-line. Some specimens of *M. protea* * from the Lower Devonian of Maine seem to resemble it, and *M. aroostooki* Williams and Breger † is allied.

Modiomorpha nigra (Reed)

906. *Sanguinolites niger* Reed, Geol. Mag., Dec. v, vol. 3, p. 304, pl. xvi, figs. 4, 4a (625b S.A. Mus.).

It is probable that this species should be rather placed in some section of the genus *Modiomorpha* than in *Sanguinolites*, and it bears not a little resemblance to *M. Hermannii* Kegel ‡ from the Taunus Quartzite. It is also much like the Bolivian species *Modiomorpha ? minuta* Kozl., § and Clarke's *Goniophora abbreviata* || from Brazil still more resembles our shell, but it is certainly not a member of *Goniophora* in the ordinary sense of the word. There is a well-preserved small specimen of a right valve showing the slightly oblique concentric striae on the surface from De Doorns in the Sedgwick Museum, and numerous internal casts occur in the Stellenbosch Museum from the road between Montagu and Triangle. Some of the figures of shells attributed to *Sphenotus truncatus* (Conr.) ¶ bear a considerable resemblance to our species, but the type form seems to be distinct.

Modiomorpha cf. *austronotica*, Clarke ?

1904. *Modiomorpha* aff. *Sellowi* Reed, Ann. S. Afr. Mus., vol. iv, pt. 6, p. 268, pl. xxxii, fig. 11 (122 S.A. Mus.).

The small shell (122 S.A. Mus.) from the top of Hottentot's Kloof, which the author considered allied to *Modiomorpha Sellowi* Clarke, may perhaps be compared with *M. austronotica* Clarke,** as it is more oval and more oblique than the former. *M. praecursor* Frech, †† from the Coblenzian of the Rhine, appears to be also related to our shell.

* Clarke, Mem. 9, New York State Mus., pt. 2, 1909, p. 107, pl. xxvi, figs. 4-8.

† Williams and Breger, *op. cit.*, 1916, p. 219, pl. xxi, figs. 2-7, 10-13.

‡ Kegel, Abh. k. preuss. geol. Landesanst., N.F., Heft 76, 1913, p. 68, t. iv, figs. 3a, b.

§ Kozłowski, *op. cit.*, 1923, p. 80, pl. viii, figs. 14, 14a, b.

|| Clarke, "Foss. devon. Parana," 1913, p. 198, pl. xvi, figs. 1, 2.

¶ Clarke, Mem. 9, New York State Mus., pt. 1, 1908, p. 232, pl. xxii, figs. 9, 10 (non figs. 11, 12).

** Clarke, *op. cit.*, 1913, p. 199, pl. xvii, figs. 5-8.

†† Drevermann, "Fauna d. Untercoblenzsch. von Oberstadtfeld," Palaeontographica, vol. xlix, pt. 2, 1902, p. 86, t. x, figs. 11-14.

Williams and Breger * think that *M. Sellowi* should be placed in the genus *Cypricardites* Conrad.

Modiomorpha cf. *scaphula* Clarke (pars) ?

There is one imperfect specimen of conjoint valves of a lamelli-branch (245 Univ. Cape) in the Cape University collection which has the beak of the right valve partly preserved. In outline and general characters it seems to be comparable to the first figured example of *Modiomorpha* ? *scaphula* Clarke † from Ponta Grossa, but is quite unlike the other specimens (*op. cit.*, pl. xvii, figs. 1, 2) from Tybagy. Our shell has no obliquely transverse depression across the valves nor any umbonal ridge, the valves being gently convex and only somewhat flattened on the sides ; the upper edge is broken as well as the sub-umbonal portion of the shell, but the concentric growth-lines and occasional stronger ridges show its general shape.

Dimensions :—

Length . . .	c. 41 mm.
Height . . .	25 mm.
Thickness . . .	14 mm.

Modiomorpha (*Modiella* ?) sp.

(Pl. V, fig. 12.)

There is one nearly perfect internal cast of a lamelli-branch in the Stellenbosch Museum which was collected from the road between Montagu and Triangle ; the posterior end is broken and part of the inferior margin is imperfect. The general shape is obliquely elongate oval, widening posteriorly ; the hinge-line is long and straight, and seems to have been at least three-fourths the length of the shell ; the beaks are low, rounded, obtuse and subanterior, being close to the anterior end, which projects a little in front of them at the inferior angle ; the inferior margin seems to have been nearly straight, but oblique. The shell is compressed anteriorly, and a broad shallow depression crosses the valve in the anterior part of the shell unusually far forward, and is bounded behind by a low rounded umbonal ridge which soon dies out posteriorly and merges into the general gentle convexity of the posterior part of the surface. The posterior end seems to have been broadly rounded, judging from the concentric lines on the surface. A weak oblique narrow groove runs back

* Williams and Breger, *op. cit.*, 1916, p. 155.

† Clarke, *op. cit.*, 1913, p. 199, pl. xvi, fig. 9 (*non* pl. xvii, figs. 1, 2, 3, 4).

behind the umbonal ridge to the posterior lower angle of the valve. The hinge-line shows the usual features. The surface is covered with concentric growth-striae, and there are distinct traces of low radial lines. In our specimen the right valve is alone well preserved. We may probably compare it with the shells from the Gaspé Sandstone of Quebec described and figured by Clarke as *Modiella modiola* Clarke,* and *Modiella pygmaea* (Conr.),† and with *Modiomorpha impar* Clarke‡ from the Dalhousie Formation. There is also figured by Clarke a small shell from Ponta Grossa attributed to *Modiomorpha* § which bears a considerable resemblance to our specimen. It should be noted that *Modiella modiola* Clarke is not identical with the European *Modiomorpha modiola* Beushausen.

Janeia Baini (Sharpe).

1856. *Modiolopsis?* *Baini* Sharpe, Trans. Geol. Soc., ser. 2, vol. vii, p. 213, pl. xxvii, fig. 9 (11344 Brit. Mus.).

1904. *Modiomorpha Baini* Reed, Ann. S. Afr. Mus., vol. iv, pt. 6, p. 267.

The shorter and more oblong shell, the more truncate posterior end and more strongly-marked umbonal ridge, are characters which enable us to distinguish this species from the very closely-allied *Janeia braziliensis* Clarke. On the same slab (111 S.A. Mus.) as that holding the so-called *Glossites* aff. *depressus* (which is probably referable to *Jan. braziliensis*) there is an example of Sharpe's species, so that they can be directly compared and their differences observed. But they are undoubtedly very closely allied.

Janeia braziliensis, Clarke.

(Pl. V, figs. 13, 13a.)

? 1904. *Glossites* cf. *depressus*, Reed, Ann. S. Afr. Mus., vol. iv, pt. 6, p. 254, pl. xxxi, fig. 5 (111 S.A. Mus.).

1908. *Modiomorpha Baini* var. Reed, *ibid.*, vol. iv, pt. 8, p. 398.

1913. *Janeia braziliensis*, Clarke, "Foss. devon. Parana," p. 190, pl. xv, figs. 11-21.

A beautifully-preserved complete example of this species (5419 S.A. Mus.) occurs in the South African Museum, showing both valves

* Clarke, Mem. 9, New York State Mus., pt. 1, 1908, p. 232, pl. xxiii, figs. 1-5.

† *Ibid.*, p. 231, pl. xxiii, figs. 6, 7.

‡ *Ibid.*, pt. 2, 1909, p. 31, pl. vi, figs. 6-8.

§ Clarke, "Foss. devon. Parana," 1913, pl. xvi, fig. 4.

with the shell preserved. It was obtained at the Kamanassie River, Oudtshoorn, and measures 55 mm. in length, 31 mm. in height, and 19 mm. in thickness. It is without doubt closely allied to Sharpe's *Modiolopsis Baini*, but has a more elongate linguiform shape, a less truncate posterior end, and a less developed umbonal ridge.

With regard to the South African shell which was compared with *Glossites depressus* Hall, Clarke* questioned the correctness of my comparison and believed it was referable to the genus *Janeia*, and it is probable that this poor specimen should be referred to *J. braziliensis*, though *Glossites amnigenoides* Will. and Breg.† from the Chapman Sandstone bears a considerable resemblance to it.

Schwarz,‡ in 1906, referred a specimen of a lamellibranch from Ezelfontein, Ceres (2575 Alb. Mus.) to the Brazilian species *Cypricardella Pohli* Clarke,§ but it is in a very poor state of preservation, and as far as its characters are recognisable it may more probably be compared with *Jan. braziliensis*. Williams and Breger,|| however, think that *Cypricardella Pohli* may belong to the genus *Anodontopsis* M'Coy, and they see in this species a resemblance to their *A. maccoyiana* Will. and Breg.¶ from the Chapman Sandstone, Maine. The true relations and position of Schwarz's specimen cannot be satisfactorily determined.

Janeia bokkeveldensis (Reed).

1908. *Solenopsis? bokkeveldensis* Reed, Ann. S. Afr. Mus., vol. iv, pts. 8, 14, p. 397, pl. xlviii, fig. 1 (1607 S.A. Mus.).

? 1913. *Janeia bokkeveldensis* Clarke, "Foss. devon. Parana," p. 193, pl. xv, figs. 1-10.

Clarke (*op. cit.*) stated that he had little doubt of the identity of certain Brazilian shells with this South African species originally described from the Zwartberg Pass. Personally I am not so sure about the matter, and Clarke's figures show a considerable diversity in form and ornamentation. The fine radial granulated lines which are conspicuous below and in front of the oblique umbonal groove in our shell do not seem to be similarly or equally developed in the South American examples. The reference of the species to *Janeia* rather than to *Solenopsis* may, however, be accepted.

* Clarke, *op. cit.*, 1913, p. 81; Williams and Breger, *op. cit.*, 1916, p. 146.

† Williams and Breger, *op. cit.*, 1916, p. 145, pl. xix, fig. 20.

‡ Schwarz, Rec. Alb. Mus., vol. i, pt. 6, 1906, p. 380, pl. viii, fig. 3.

§ Clarke, Archiv Mus. Nac. Rio de Janeiro, vol. x, 1899, p. 64, pl. vi, fig. 10.

|| Williams and Breger, *op. cit.*, 1916, p. 238.

¶ *Ibid.*, p. 236, pl. xxiv, fig. 14; pl. xxvi, figs. 2, 3, 5-7, 10, 12, 13.

Janeia bokkeveldensis (Reed), var. *acer* (Reed).

1906. *Sanguinolites?* *acer* Reed, Geol. Mag., Dec. v, vol. iii, p. 305, pl. xvi, figs. 5, 5a, 5b (625c S.A. Mus.).

In the figure which was given by the author of this shell which was collected at the Zwartberg Pass, the oblique sulcus is rather too much emphasised, while the concentric lines and rugae were not drawn sufficiently oblique; the valve was made too flattened and not convex enough in the side view, and the beak was represented as less obtuse than it should be. The presence of fine but distinct equidistant radial lines crossing the radial lines and thus producing small granules at their intersection was not noted.

The shell seems to be a short variety of *J. bokkeveldensis*, for the ornamentation of the surface, the oblique narrow sulcus, and the obtuse beak resemble this species very closely. The more pointed postero-inferior angle shown in my original figure seems due to the upper posterior margin being imperfect, the course of the concentric lines and rugae giving the true shape of the shell. Knod * has figured a Bolivian shell as *Sphenotus Bodenbenderi*, showing radial lines on the surface; but the reference of our specimen from the Zwartberg Pass to *Janeia* can hardly be doubted.

Grammysia (*Grammysioidea*) *corrugata* (Sharpe).

1856. *Sanguinolites?* *corrugatus* Sharpe, Trans. Geol. Soc., ser. 2, vol. vii, p. 212, pl. xxvii, fig. 8 (11343, 14850 Brit. Mus.).
 1904. *Grammysia corrugata* Reed, Ann. S. Afr. Mus., vol. iv, pt. 6, p. 253.
 1906. *Nyassa arguta?* Reed, Geol. Mag., Dec. v, vol. iii, p. 303, pl. xvi, figs. 3, 3a.
 1908. *Nyassa arguta* Reed, Ann. S. Afr. Mus., vol. iv, pt. 8, p. 398.
 Cf. 1913. *Macrodon?* sp. Clarke, "Foss. devon. Parana," p. 184, pl. xvi, fig. 8.

After a further examination of Sharpe's type in the British Museum and a comparison with the shells which I referred to *Nyassa arguta* Hall, in 1906-8, it seems practically certain that they are identical. Sharpe's figure does not make the beaks sufficiently obtuse and rounded, nor the valves sufficiently swollen and sinuated.

A fairly well-preserved specimen, probably referable to the same species, was collected by Dr. Rastall at De Doorns and is now in the

* Knod, *op. cit.*, 1908, p. 529, t. xxv, fig. 5 (*non* 6, 7).

Sedgwick Museum; it measures about 30 mm. in length and about 18 mm. in height at the beak. It is noticeable that Clarke's figures of *Modiomorpha? scaphula** from Tybagy, Brazil (but not those from Ponta Grossa), seem to represent a very similar shell, but at any rate I believe our Bokkeveld shell is referable to *Grammysia* (*Grammysioidea*).†

Grammysia (*Grammysioidea*) *fontinalis* (Reed).

1908. *Leptodomus? fontinalis* Reed, Ann. S. Afr. Mus., vol. iv, pt. 8, p. 395, pl. xlvii, figs. 14, 14a (183a S.A. Mus.).

The resemblance of this species is very close to *Grammysia Lundi* Clarke,‡ and it may be identical with it or with *Gr. Gardneri* Clarke,§ also from Brazil, both of which seem to belong to the same subgenus *Grammysioidea*. There is so much confusion about the use of the name *Leptodomus* || that it is better not to apply it to this species, which does not seem to fit in with the revised and restricted definition of this genus.

Grammysia (*Grammysioidea*) *montana* Reed.

1908. *Grammysia montana* Reed, Ann. S. Afr. Mus., vol. iv, pt. 8, p. 395, pl. xlviii, fig. 2 (1805 S.A. Mus.).

As the author pointed out, this species is closely allied to *Grammysia Lundi* Clarke, which Williams and Breger¶ put in their new subgenus *Grammysioidea*, comprising a group of shells which are particularly abundant in the Lower Devonian.

Grammysia (*Grammysioidea*) *campestris* (Reed).

1904. *Cardiomorpha campestris* Reed, Ann. S. Afr. Mus., vol. iv, pts. 6, 11, p. 254, pl. xxxi, fig. 6 (102 S.A. Mus.).

? 1923. *Grammysia rara* Kozłowski, Ann. Paléont., vol. xii, p. 76, pl. x, figs. 14, 14a.

The shell described and figured from Bolivia by Kozłowski under the name *Grammysia rara* sp. nov. seems almost inseparable from the

* Clarke, *op. cit.*, 1913, p. 199, pl. xvii, figs. 1, 2 (*non* 3, 4).

† Williams and Breger, *op. cit.*, 1916, p. 134.

‡ Clarke, Archiv Mus. Nac. Rio de Janeiro, vol. x, 1899, p. 66, t. vi, figs. 11-13.

§ *Ibid.*, p. 67, t. vii, fig. 10.

|| Williams and Breger, *op. cit.*, 1916, p. 130.

¶ *Ibid.*, p. 134.

Ezelfontein specimen which the author named *Cardiomorpha campestris*. The short subquadrate form, the position and size of the beaks, the somewhat inflated valves with a short hinge-line and other characters appear to agree in every detail. Probably the species should be placed in the genus or subgenus *Grammysioidea* and be compared with *Gr. Lundi* Clarke and *Gr. fontinalis* Reed, rather than with any species of *Cardiomorpha*.

Grammysia (Grammysioidea) scaphuloides sp. nov.

(Pl. VI, figs. 4, 5.)

1904. *Grammysia* sp. Reed, Ann. S. Afr. Mus., vol. iv, pt. 6, p. 252, pl. xxxi, fig. 3 (214 S.A. Mus.).

Shell transversely subelliptical to subquadrate, widening a little posteriorly, inflated. Beaks broad, obtuse, swollen, rounded, incurved, subanterior, situated at about one-fourth (or less) the length of the shell and rising above the hinge-line. Anterior end of valves sharply rounded, meeting hinge-line at rounded angle; inferior margin gently arched, long; posterior end obtuse, broadly rounded, meeting hinge at obtuse angle; hinge-line straight, about two-thirds the length of shell. Surface of valves swollen, convex, rounded, without sulcus or umbonal ridge, ornamented with a few (6-7) strong, subequal, coarse, overlapping, slightly oblique concentric lamellae, set at subequal distances apart, with fine concentric striae between them.

Dimensions :—

	(72 Univ. Cape.)	(192 S.A. Mus.)
Length of shell . . .	48 mm.	c. 34 mm.
Height „ at beak . . .	32 „	c. 22 „

Remarks.—There is a good specimen of a right valve in the collection of the Cape University (No. 72) from Ezelfontein, Ceres, and a poorer one (192 [6708] S.A. Mus.) of another right valve somewhat crushed from Riet Vallei, E.N.E. of Ceres, in the South African Museum. The oblique sulcus across the surface of the latter seems due to an injury, and the description of the species is drawn up from the other specimen. It much resembles *Gr. fontinalis*, but the less anterior beak, straight and longer hinge-line and strong concentric lamination, distinguish it. In outline and breadth of beak at about one-fourth the length of the hinge-line it resembles an unnamed species of *Grammysia* figured by Knod * from Bolivia. The coarse lamellation of

* Knod, *op. cit.*, 1908, p. 529, t. xxv, fig. 10.

the surface recalls *Gr. corrugata* (Sharpe) which is undoubtedly allied, but can hardly be regarded as identical.

There is an imperfect and crushed more subquadrate specimen (197 S.A. Mus.) from Riet Vallei, E.N.E. of Ceres, which has the anterior part of the left valve well preserved with the shell still attached and shows the coarse concentric lamellae and finer intermediate concentric lines very distinctly. The outline of this specimen differs somewhat from the type, but this is apparently due to its crushed condition. The same remark applies to the specimen (214 S.A. Mus.) from Ezelfontein, Ceres, figured by the author in 1904 (*op. cit.*) as *Grammysia* sp. Traces of fine radial striae are visible in one specimen (110 Univ. Cape) from between Montagu and Triangle which closely resembles in this respect, as it does in general shape and position of the beak, the shells from Tybagy, Brazil, figured by Clarke * as *Modiomorpha? scaphula*, but all our specimens are quite unlike the first figured example of this species (*op. cit.*, pl. xvi, fig. 9), which has much less coarse concentric lamination and a less obtuse and less incurved beak as well as no transverse broad oblique depression.

Goniophora gydoensis sp. nov.

(Pl. V, fig. 11.)

Shell very elongated, sub lanceolate, acutely pointed posteriorly; inferior margin very gently arched; hinge-line straight, about half length of shell, subparallel to inferior margin; posterior end of shell obliquely truncate, gently arched, making angles of about 130° with hinge-line, and of about 45° with inferior margin; anterior end narrow (not well preserved). Beaks subterminal. Valves deep, traversed by strongly raised angular umbonal ridge running from beak to acute postero-inferior angle, rising to maximum height at about one-third the length of the shell; surface of valves flattened above and to a less extent below umbonal ridge, and marked with thick regular raised thread-like concentric lines of equal strength, sharply bent back on crossing the umbonal ridge.

Dimensions (5436 S.A. Mus.):—

Length	c. 35 mm.
Height at posterior end of hinge-line	14 mm.

Remarks.—There is only one specimen (a left valve) of this new species from Gydo Pass, Ceres, but it is in a good state of preservation

* Clarke, *op. cit.*, 1913, p. 199, pl. xvii, figs. 1, 2 (*non* 3, 4): (*non* pl. xvi, fig. 9).

with the exception of the anterior end. It seems more allied to the European species *Goniophora acuta* Sandb.,* *G. nassoviensis* Kayser,† and *G. kilmoriensis* Reed,‡ than to any South American species. But *G. hamiltonensis* § Hall, of the Middle Devonian of New York and Maryland, bears a great resemblance to it. A discussion of the characteristics and limitations of the genus is given by Williams and Breger, and they state that it attains the acme of its development in the Lower Devonian.||

Goniophora ? sp.

1904. *Modiomorpha* cf. *pimentana* Reed, Ann. S. Afr. Mus., vol. iv, pt. 6, p. 268, pl. xxxii, fig. 10 (146 S.A. Mus.).

The specimen which was compared by the author in 1904 with *Modiomorpha pimentana* Hartt and Rathbun ¶ appears on further examination to be more probably referable to some species of *Goniophora*, and some of the shells which Clarke** described from the Moose River Sandstone, Maine, as *Cardiomorpha* (*Goniophora*)? *simplex* bear a considerable resemblance. But certain European species of *Sphenotus*, such as *Sph. elongatus* Spriest.†† and *Sph. carinatus* Spriest.,‡‡ have much the same external appearance, and the generic reference must remain somewhat doubtful.

Sanguinolites albanus, Reed.

1925. *Sanguinolites albanus* Reed, Rec. Albany Mus., vol. iii, pt. 4, p. 257, pl. ix, figs. 1 and 3 ; pl. x, fig. 4.

Shell elongate-subelliptical with broadly rounded subequal ends, compressed laterally, gaping behind ; inferior margin nearly straight and parallel to hinge-line, with very weak broad median emargination

* Beushausen, Abh. k. preuss. geol. Landesanst., N.F., Heft 17, 1895, p. 211, t. xvii, figs. 1-3.

† *Ibid.*, p. 203, t. xvii, figs. 4-9.

‡ Reed, Geol. Mag., vol. lix, 1922, p. 306, pl. xii, figs. 2, 2a, b.

§ Prosser and Kindle, Maryland Geol. Surv., 1913, Devonian, p. 271, pl. xxxiii, figs. 11-13.

|| Williams and Breger, *op. cit.*, 1916, p. 223.

¶ Clarke, *op. cit.*, 1899, p. 52, pl. vi, figs. 4-9.

** Clarke, Mem. 9, New York State Mus., pt. 2, 1909, p. 77, pl. xv, figs. 8, 9 (*non* 7, 10, 11).

†† Spriesterbach, Abh. k. preuss. geol. Landesanst., N.F., Heft 80, 1915, p. 68, t. xix, figs. 1-5.

‡‡ *Ibid.*, p. 67, t. xviii, fig. 5.

corresponding to faint lateral depression or flattening of sides ; hinge-line straight with edges slightly exsert, nearly as long as shell. Beaks low, broad, obtuse, situated at about one-third the length of the shell from front end. Surface of valves ornamented with strong broad rounded subequidistant concentric rugae having fine concentric striae between them.

Dimensions (102 Alb. Mus.): Length, 36 mm.; Height, 21 mm.; Thickness, 16 mm.

Remarks.—There is only one example of this species, but it is complete with both valves, and has the shell preserved ; the posterior end is slightly broken, but its outline is easily determined from the concentric rugae. It was labelled “*Palaeoneilo antiqua*, A. G. Bain Collection.” With regard to its affinities it is more like the shell figured by Kayser * from the Argentine Devonian as *Leptodomus* sp. than the Brazilian *L. capricornus* Clarke,† for the latter has the shell too elongate, the beaks too forward, and the posterior end more truncate above.

Lept. prunus Clarke,‡ and *Lept. corrugatus* Clarke,§ from the Lower Devonian of North America, may also be compared, and Clarke thinks that the former is closely related to *L. striatulus* (Roemer) || of the Upper Coblenzian, but the latter is quite unlike our shell. The generic name *Leptodomus* has been applied in more than one sense by various writers, and M'Coy's ¶ original application to Carboniferous shells has been lost sight of. Beushausen (*op. cit.*, p. 264) was unable to define clearly the difference between this genus and *Allerisma* (= *Allorisma* Auctt.) King 1849. Wheelton Hind ** points out how M'Coy subsequently changed the scope and definition of *Leptodomus* and thereby caused such confusion that its present retention is of dubious value, and the position and characterisation of the genus is most unsatisfactory. He, therefore, distributes most of M'Coy's species amongst the genera *Protoschizodus*, *Sanguinolites*, and *Allorisma*, and it is probably to the genus *Sanguinolites* that this Bokkeveld specimen should be referred.

In Eastman Zittel's Textbook of Palaeontology, vol. i (1913), p. 439,

* Kayser, Zeitschr. deut. geol. Gesell., vol. xlix, 1897, p. 289, t. x, fig. 6.

† Clarke, “Foss. devon. Parana,” 1913, p. 197, pl. xvi, figs. 14–18.

‡ Clarke, Mem. 9, New York State Mus., pt. 2, 1909, p. 76, pl. xvi, fig. 6.

§ *Ibid.*, p. 109, pl. xxviii, fig. 6.

|| Beushausen, *op. cit.*, p. 265, t. xxiv, figs. 12–14.

¶ M'Coy, Syn. Carb. Foss. Ireland, 1844, p. 67, pl. x, fig. 11.

** Wheelton Hind, “Mon. Carb. Lamellibr.” Palaeont. Soc. 1898 and 1900, pp. 226, 361, 363, 419.

the genus *Leptodomus* is given as only occurring in the Silurian. Williams and Breger * state that *Sanguinolites* gapes behind but not in front, whereas *Leptodomus* gapes at both ends.

Sanguinolites ? sp.

1904. *Sanguinolites* sp. Reed, Ann. S. Afr. Mus., vol. iv, pt. 6, p. 252, pl. xxxi, fig. 4 (98 S.A. Mus.).

The figure of this shell (98 S.A. Mus.) from Ceres which was given by the author in 1904 hardly gives a correct idea of its characters. The shell is made too short and the convexity from the beak to the postero-inferior angle and from the hinge-line to the inferior margin is made insufficient. There seems to have been a weak emargination below the beak on the anterior margin. The impressed line mentioned by me (*op. cit.*) as crossing the shell obliquely seems to be due to an accidental injury. The concentric markings on the shell are made in my figure to look like imbricating lamellae instead of as low rounded rugae. We may also remark that a definite umbonal ridge is wanting, and it should be stated that the straight hinge-line is only about four-fifths the length of the shell.

Williams and Breger think that this Bokkeveld shell resembles their *Modiomorpha* (*Endodesma*?) *Chapmani* † from the Chapman Sandstone of Maine, but it seems to me more like some species of *Sanguinolites* or *Leptodomus*, using the latter name in the same manner as Clarke.

Sphenotus ? cf. *Gorceixi* Clarke.

1904. *Orthonota* aff. *undulata* Reed, Ann. S. Afr. Mus., vol. iv, pt. 6, p. 251, pl. xxxi, fig. 2 (101 S.A. Mus.).

The accuracy of the view which the author expressed in 1904 that this shell was allied to *Orthonota undulata* Conr., was doubted by Clarke,‡ but no further specimens with similar characters have been found in the Bokkeveld Beds, so that the determination of its affinities rests on no new evidence. The specimen is so crushed that its present characters may not be original, but this remark hardly applies to the radial folds. We may, however, add to the original description that there are fine radial striae parallel to the hinge-line along the edges and slopes of the elongated lanceolate ligamental area, and that there is no anterior lunule present. Though there are certain species of

* Williams and Breger, *op. cit.*, 1916, p. 130.

† *Ibid.*, p. 221, pl. xx, figs. 1-7.

‡ Clarke, *op. cit.*, 1913, p. 81.

Orthonota in the Lower Devonian of Germany (such as *O. costata* Kegel, and *O. triplicata* Fuchs), which bear a considerable resemblance to our shell in the possession of radial costae, yet if we bear in mind that our specimen is crushed and distorted we can see a greater resemblance to some examples of *Sphenotus truncatus* Conr.* which has the broad postumbonal slope traversed by a low intermediate ridge, and such is also the case in one small figured specimen of *Sph. Gorceixi* Clarke † from Brazil, with which our shell may probably be compared. Williams and Breger ‡ consider that their *Orthodesma carinifera* sp. nov. from the Chapman Sandstone much resembles the latter Brazilian shell.

Sphenotomorpha Bodenbenderi (Clarke) var. nov. *capensis*.

(Pl. VI, fig. 10.)

Shell transversely elongate, not widening posteriorly, the superior and inferior margins being subparallel; anterior end sharply rounded; posterior end broadly rounded, obliquely truncated above, bluntly pointed below; cardinal margin long, straight, extending three-fourths the length of the shell behind the beaks; inferior margin nearly straight, very slightly arched, without any insinuation. Beaks low, broad, obtuse, situated near anterior end at about one-sixth the length of the shell, incurved, slightly directed forwards, with indefinite lunule below them. Surface of valves moderately convex, most so at about their middle, with a weak oblique umbonal ridge running back from beak at an angle of 45° to hinge-line but becoming obsolete posteriorly; surface of valves in front of ridge somewhat flattened and crossed by strong concentric growth ridges and striae of unequal strength; surface above ridge gently convex or somewhat flattened, with weaker finer concentric markings not angulated on crossing the umbonal ridge.

Dimensions (2019 Kimb. Mus.):—

Length	.	.	.	38 mm.
Height	.	.	.	15 „
Thickness	.	.	.	16 „

Remarks.—The specimen from which the above description is

* Hall, Palaeont. New York, vol. v, 1885, pt. 1, p. 394, pl. lxiv, figs.; Clarke, Mem. 9, New York State Mus., pt. 1, 1908, p. 232, pl. xxii, fig. 11 (*non* figs. 9, 10, 12).

† Clarke, Archiv Mus. Nac. Rio de Janeiro, vol. x, 1899, p. 59. t. v, fig. 14 (*non* 15, 16).

‡ Williams and Breger, *op. cit.*, 1916, p. 126, pl. xix, fig. 2.

drawn up is in the Kimberley Museum (No. 2019), and consists of a complete specimen, both valves being preserved and only the left one slightly crushed and distorted. The locality given is simply "Bokkeveld." Another rather larger specimen in a similar state of preservation was obtained by myself from the roadside cutting north of De Doorns, but it is more crushed, the thickness being exaggerated and the umbonal ridge accentuated by dorso-ventral compression. A third specimen (303 Cape Univ.) from Keurbosch, in the Hex River district, has the beaks crushed in, but the valves are more uniformly convex, and no umbonal ridge seems to be present, and it is more like the typical *Sphenotus Bodenbenderi* Clarke* of the Brazilian Devonian. We may probably refer all of them to the same species, and, apart from the absence of the diagonal furrow which is a noticeable feature in *Sphenotus Bodenbenderi*, there seems to be no difference of specific value. *Orthonota paranensis* Kozl.† from Bolivia may well belong to the same genus, if not species, rather than be allied to *O. undulata* Conr. *Sphenotus elongatus* Spriest.‡ appears to bear much resemblance. Williams and Breger§ put *Sph. Bodenbenderi* in their new genus *Sphenotomorpha*.

Toeichomya ? rudis (Sharpe).

1856. *Anodontopsis ? rudis* Sharpe, Trans. Geol. Soc., ser. 2, vol. vii, p. 213, pl. xxvii, fig. 10 (11345 Brit. Mus.).

Clarke|| established the subgenus *Toeichomya* as a subgenus of *Schizodus* Auctt. on the strength of the dentition and internal characters, and chose as the type *T. Rathbuni* sp. nov. from the Devonian of Para. With the external outline and general shape and characters of this species Sharpe's *Anodontopsis ? rudis* appears to correspond most closely and indeed to be almost identical, for the beak should be rather more subcentral and anterior, and the hinge-line longer and straighter behind and rather straighter in front than Sharpe's figure indicates. No other specimen of this peculiar shell has been recognised in any of the collections, and its internal characters are unknown. Williams

* Clarke, Archiv Mus. Nac. Rio de Janeiro, vol. x, 1899, p. 58, t. v, fig. 17; t. viii, figs. 25, 26.

† Kozłowski, Ann. de Paléont., vol. viii, 1913, p. 12, pl. iii, figs. 3, 4.

‡ Spriesterbach, Abh. k. preuss. geol. Landesanst., N.F., Heft 80, 1915, p. 68, t. xix, figs. 1-5.

§ Williams and Breger, *op. cit.*, 1916, pp. 233-236.

|| Clarke, Archiv Mus. Nac. Rio de Janeiro, vol. x, 1899, pp. 54-57, t. viii, figs. 23, 24.

and Breger * regard M'Coy's genus *Anodontopsis* (genotype *A. angustifrons*) as not congeneric with *Cypricardella* Hall (*Microdon* Conrad), of which the genotype comes from the Hamilton Formation of New York. But M'Coy's genus is heteromorphous, and the other species which he placed in it have to be distributed amongst several genera, *A. quadratus* and *A. securiformis* being schizodiform shells. *A. maccoyiana* Will. and Breg.† from the Chapman Sandstone is quite distinct from the Bokkeveld shell.

Buchiola subpalmata, Reed.

1906. *Buchiola subpalmata* Reed, Geol. Mag., Dec. v, vol. iii, p. 302, pl. xvi, figs. 1, 1a, 2.

No further examples of this species have come under my observation except one (593) in the Kimberley Museum from Prince Albert, and it is remarkable that the genus has not yet been recorded from the South American Devonian. In North America the genus is well represented in the Upper Devonian (Naples fauna),‡ and its presence in these Bokkeveld Beds suggests that some higher stage than Lower Devonian may occur in the series unless the genus appeared earlier in South Africa than it did in Europe or North America.

The types of *B. subpalmata* were collected on the Zwartberg Pass.

Buchiola sp. ind.

1906. *Buchiola* sp. ind. Reed, Geol. Mag., Dec. v, vol. iii, p. 303.

The characters of this species cannot be satisfactorily defined in the absence of further material.

Cardiola sp. ind.

(Pl. VI, fig. 13.)

A very minute complete internal cast of a lamellibranch about 1.5 mm. long, from Zwartberg Pass, occurs in the collection presented in 1906 to the Sedgwick Museum by the South African Museum. The shell is obliquely suboval, narrowing behind, and is rather strongly biconvex; the umbo is subcentral, being situated in the middle of the hinge-line, but at about one-third the length of the shell, and is rather prominent and swollen, rising well above the short straight

* Williams and Breger, *op. cit.*, 1916, pp. 239-244.

† *Ibid.*, p. 236, pl. xxiv, fig. 14; pl. xxvi, figs. 2, 3, 5-7, 10, 12, 13.

‡ Clarke, Mem. 6, New York State Mus., 1904, pp. 295-303.

hinge-line which is less than half the length of the shell. The anterior cardinal angle is obtuse, the anterior margin being broadly rounded or obliquely subtruncate, and then sweeping round below into the strongly-arched inferior margin which curves round sharply at the narrower posterior angle; the posterior margin is subtruncate and nearly straight, meeting the hinge-line at an angle of about 140° . The anterior part of the valves is rather swollen and inflated, descending somewhat steeply in front; there is no umbonal ridge, and no trace of teeth is visible or of ribs on the surface. We may probably refer this shell to some species of *Cardiola* like *C. concentrica* (von Buch) var. *irregularis* Beush.* or *C. ? arciformis* Beush.,† but it is more oblique and narrows more posteriorly than either of them.

Praecardium bokkeveldense, Reed.

1925. *Praecardium bokkeveldense* Reed, Rec. Albany Mus., vol. iii, pt. 4, p. 259, pl. ix, figs. 2, 4, 5.

Shell subtriangular, cardiiform, nearly as high as long, somewhat inflated. Beaks subanterior, pointed, somewhat incurved. Anterior end of shell sharply rounded below, but gently concave in upper half; inferior margin of shell forming a broadly-rounded curve; posterior margin nearly straight, obliquely truncated, meeting the inferior margin at the posterior angle at about 80° . Valves convex, rather swollen on sides, but abruptly truncated behind, the surface above the angular umbonal ridge being flattened and nearly at right angles to the sides, thus forming a large elongated lanceolate posterior area behind the hinge-line. Anterior lunule below beaks shorter and smaller than posterior area, sublanceolate, depressed. Hinge-line short, straight, with one stout triangular peg-like tooth in right valve fitting between two similar teeth in left valve; hinge thickened. Anterior adductor scars small, ill-defined, situated just below lunule close to margin; posterior adductor scars indicated by large curved impressions at end of hinge-line on posterior lanceolate area. Surface of shell ornamented with low, coarse, rounded, closely-placed radial ribs.

Dimensions (91 Alb. Mus.):—

Height . . .	25 mm.
Length . . .	28 „
Thickness . . .	19 „

Remarks.—There is only one specimen of this shell, consisting of

* Beushausen, Abh. k. preuss. geol. Landesanst., N.F., Heft 17, 1895, p. 355. t. xxxvii, figs. 18, 19.

† *Ibid.*, p. 357, t. xxxvii, figs. 11, 12.

the complete internal cast of both valves. The external characters, therefore, are rather doubtful, but distinct traces of 3-4 low rounded radial ribs show near the margin in one part, and similar ones probably covered the whole surface.

With regard to the generic position of this shell it is probable that it should be placed in the genus *Praecardium*, or perhaps *Puella*, on account of the presence of teeth, instead of in one of the *Cardiolidae*, which are edentulous.*

The shape of the shell, the high incurved beaks, the anterior lunule, the posterior flattened area, and the radial ribbing would suggest also a comparison with the Devonian species *Opisthocoeus alternans* (Holzapfel) † if the latter were not stated to be edentulous. Clarke ‡ has figured a shell from the New York Oriskany as *Lunulicardium?* sp., which seems to have much the external shape and ornamentation of our Bokkeveld specimen and to be more like it than *Lunulicardium? convexum* Clarke,§ from the Gaspé Sandstone, Quebec.

Myalina brevicardinalis sp. nov.

(Pl. VI, fig. 9.)

Shell large, flattened, compressed, obliquely and broadly mytiloid. Beak small, prominent, acute, anterior, terminal; hinge-line short, straight; posterior margin oblique, meeting hinge-line at large obtuse angle (about 130°), nearly straight in upper half, then curving round below to pass into short sharply-arched inferior margin which sweeps up into long, gently-convex anterior margin, becoming concave and curving in below beak. Surface of valves flattened without any umbonal ridge, very gently convex, marked with concentric sublamellose growth ridges and striae.

Dimensions (7202 S.A. Mus.) :—

Length (oblique) . . .	80 mm.
Length of hinge-line . . .	20 „
Height (max.) . . .	50 „

Remarks.—There is only one right valve (7202 S.A. Mus.) of this

* Douvillé, Bull. Soc. Geol. France, ser. 4, vol. xii, 1912, p. 444; Eastman-Zittel, Textbook of Palaeontology, vol. i, 1913, p. 439.

† Beushausen, Abh. k. preuss. geol. Landesanst., N.F., Heft 17, 1895, p. 340, t. xxxviii, figs. 14-17.

‡ Clarke, Mem. 9, New York State Mus., pt. 2, 1909, p. 141, pl. xxxiii, fig. 23.

§ Clarke, *ibid.*, pt. 1, 1908, p. 234, pl. xxiii, fig. 12.

shell, but it is quite distinct from any other Bokkeveld form, and is somewhat like *Myalina maureriana* Will. and Breg,* or one of its varieties from the Chapman Sandstone of Maine. We may also compare *M. pterinaeoides* Clarke † from the same formation.

Actinopteria Eschwegii, Clarke.

1899. *Actinopteria Eschwegii* Clarke, Archiv Mus. Nac. Rio de Janeiro, vol. x, p. 45, t. v, figs. 1, 2, 4, 5, 6, 8, 9, 10.
 ? 1899. *Actinopteria Humboldti*, Clarke, *ibid.*, p. 47, t. v, figs. 3, 7, 11, 12.
 1904. *Actinopteria* aff. *Boydii* Reed, Ann. S. Afr. Mus., vol. iv, pt. 6, p. 266, pl. xxxii, fig. 9 (81 S.A. Mus.).
 ? 1904. *Actinopteria* sp., *ibid.*, p. 267.
 1905. *Actinopteria Eschwegii* Thomas, Zeitschr. deut. geol. Gesell., Bd. lvii, p. 257, t. viii, fig. 29.
 1908. *Actinopteria Eschwegii* Knod, Neues Jahrb. f. Miner., Beil. Bd. xxv, p. 533.
 1908. *Actinopteria* aff. *Humboldti*, Reed, Ann. S. Afr. Mus., vol. iv, pt. 8, p. 399, pl. xlviii, fig. 3.

The two Bokkeveld specimens which were respectively considered allied to *A. Boydii* Conr. and *A. Humboldti* Clarke by the present author may both be referred to the species *A. Eschwegii* Clarke, and I have much doubt whether the typical *A. Humboldti* is specifically distinct. Williams and Breger ‡ believe that *A. Boydii* Conr. belongs to the new genus *Actinopterella*,§ but Kegel || puts it in the genus *Leiopteria*, following Spriesterbach's usage.

Pterinopecten ? sp.

1904. *Byssopteria* ? sp. Reed, Ann. S. Afr. Mus., vol. iv, pt. 6, p. 265, pl. xxxii, fig. 8 (82 S.A. Mus.).

The true generic or subgeneric reference of this Pterinea-like shell is doubtful. It may belong to the subgenus *Orbipecten* Frech, or to *Pterinopecten*, and on the whole it seems more likely to belong to the

* Williams and Breger, *op. cit.*, 1916, p. 213, pl. xviii, figs. 1-6, 8, 11; pl. xix, figs. 22, 26.

† Clarke, Mem. 9, New York State Mus., pt. 2, 1909, p. 106, pl. xxv, figs. 12-18; pl. xxvi, figs. 1-3.

‡ Williams and Breger, *op. cit.*, 1916, p. 184.

§ Williams, Proc. U.S. Nat. Mus., vol. xxxiv, 1908, p. 87.

|| Kegel, Abh. k. preuss. geol. Landesanst., N.F., Heft 76, 1913, p. 58.

latter, for *Pterinopecten proteus* Clarke* of the North American Lower Devonian appears to possess a somewhat similar shape.

Hyolithes subaequalis (Salter).

1856. *Theca subaequalis* Salter, Trans. Geol. Soc., ser. 2, vol. vii, p. 215, woodcuts figs. 3, 4, p. 214 (11351 Brit. Mus.).
 1904. *Hyolithes subaequalis* Reed, Ann. S. Afr. Mus., vol. iv, pt. 6, p. 247.
 1908. *Hyolithes subaequalis* Reed, *ibid.*, vol. iv, pt. 8, p. 387.
 1913. *Hyolithes subaequalis* Clarke, "Foss. devon. Parana," p. 163, pl. viii, figs. 7, 8.

The close resemblance of this species to the Bolivian *H. schencki* Ulrich† has been previously mentioned by me, and it is probable that they are identical. The original specimen (11351 Brit. Mus.) occurs in association with the type of *B. quadrilobatus*. *H. oxyis* Clarke,‡ from the Lower Devonian of the Gaspé region, may also be compared.

Hyolithes D'Orbigny, Kozłowski, var. nov. *capensis*.

(Pl. VII, figs. 2, 2a-c.)

Cf. 1923. *Hyolithes d'Orbigny* Kozłowski, "Faune Devon. Bolivie," Ann. Paléont., vol. xii, p. 71, pl. x, figs. 8-11.

There is one good example of a *Hyolithes* from the Zwartberg Pass which can scarcely be distinguished from the Bolivian *H. D'Orbigny*. It is in the Kimberley Museum (2018 Kimb. Mus.), and there is also the impression of the exterior of the same individual showing the ventral (convex) face on which the longitudinal as well as the transverse striae are visible. The internal cast of which the tip is broken shows the impressed line at the lateral angles, which Kozłowski mentions. The specimen now measures 32 mm. in length, 14 mm. in diameter at its upper end, and 9 mm. in thickness, but when perfect it must have had a length of about 42 mm. Our shell differs from the South American species in the longitudinal striae being very delicate and much finer than the transverse growth-striae instead of being equal to them in size.

* Clarke, Mem. 3, New York State Mus., 1900, p. 32, pl. iv, figs. 4-8; *ibid.*, Mem. 9, pt. 2, 1909, p. 156, pl. xix, figs. 2, 3.

† Ulrich, Neues Jahrb. f. Miner., Beil. Bd. viii, 1893, p. 37, t. iii, figs. 9a-d; Knod, *ibid.*, Beil. Bd. xxv, 1908, p. 517, t. xxiii, fig. 7.

‡ Clarke, Mem. 9, New York State Mus., pt. 1, 1908, p. 143, pl. xii, figs. 10-13.

Conularia africana, Sharpe.

1856. *Conularia africana* Sharpe, Trans. Geol. Soc., ser. 2, vol. vii, p. 214, pl. xxvii, figs. 13*a*, 13*b* (11348 Brit. Mus.) [*non* fig. 13*c* (11349 Brit. Mus.)].
1904. *Conularia africana* Reed, Ann. S. Afr. Mus., vol. iv, pt. 6, p. 247 (for earlier references).
1906. *Conularia africana* Schwarz (pars), Rec. Albany Mus., vol. i, pt. 6, p. 362 (*non* pl. vii, figs. 13, 14, 15).
- ? 1908. *Conularia africana* Knod, Neues Jahrb. f. Miner., Beil. Bd. xxv, p. 516, t. xxiii, figs. 8, 9.
1913. *Conularia africana*, Clarke, "Foss. devon. Parana," p. 160, pl. viii, figs. 12-15.
1920. *Conularia africana* Douglas, Quart. Journ. Geol. Soc., vol. lxxvi, p. 37, pl. i, fig. 1.
- ? 1923. *Conularia africana* Kozłowski, Ann. Paléont., vol. xii, p. 67, pl. vii, figs. 1-3.

The best collection of examples of this genus from the Bokkeveld Beds is in the Albany Museum, but not all the specimens which Schwarz recorded under the name *africana* can be left in it. The state of preservation and the fragmentary condition of many of the specimens makes the specific determination a frequent matter of difficulty. The type specimen (Sharpe, pl. xxvii, figs. 13*a*, 13*b*) (11348 Brit. Mus.) is in the British Museum and was obtained from the Cedarberg. Kozłowski (*op. cit.*) separates the Bolivian representatives of this species described by Ulrich, Knod, and himself as a distinct variety which he terms *striatula* owing to the presence of longitudinal striations; but whether their absence is due to the state of preservation or not is uncertain, for some of the Bokkeveld specimens seem to possess them on parts of the surface, though elsewhere indistinguishable.

In the type specimen of *C. africana* Sharpe (*op. cit.*, figs. 13*a*, 13*b*) (11348 Brit. Mus.) the transverse ribs on the faces of the shell are interrupted by a median longitudinal more or less impressed line, and the two halves of the ribs slightly overlap or alternate, but towards the mouth they are continuous, the median line disappearing, and they undulate in a gentle upward curve or run nearly straight across. The peculiar appearance of double lines with a fine groove between them together forming the transverse ribs which Sharpe represents in his figure and describes as "two sharp ridges enclosing a rounded furrow," are due to the fact that the transverse ribs are hollow and have had their crests abraded. They show no trace of tubercles.

Conularia africana Sharpe var. nov. *albertensis*.

(Pl. VII, figs. 3, 3a, b.)

? 1893. *Conularia undulata* Ulrich (*non* Conrad), Neues Jahrb. f. Miner. Geol., Beil. Bd. viii, p. 31, t. iii, figs. 6a, 6b.

Shell elongated pyramidal, quadrangular in cross section, rectangular, tapering to apex at about 1 in 3, and slightly curved to one side. Sides flat, of unequal width, the anterior and posterior faces being wider than the lateral ones; each face marked with strong impressed median longitudinal line and each angle infolded and grooved for its whole length; faces crossed by regular equal equidistant thick transverse thread-like lines (ribs), very minutely granulated along sharp crest, gently arched upwards, but not angulated on crossing median longitudinal line nor alternating on opposite sides of it; 8-9 transverse lines in a space of 5 mm., separated by concave rounded smooth grooves fully twice the width.

Dimensions (2017 Kimb. Mus.):—

Length of specimen (apex missing)	.	80 mm.
Estimated length of perfect specimen	.	110 „
Width of anterior face at upper end	.	36 „
„ lateral „ „ „	.	32 „

Remarks.—There is one good specimen from Prince Albert in the Kimberley Museum (2017 Kimb. Mus.). It differs from *C. africana* in having the strong median impressed line for the whole of each face, and the minutely-granulated finer transverse lines, though the rate of tapering and gently arching of the transverse lines agree.

The *C. undulata* Conr. described by Ulrich * from Bolivia agrees in shape, rate of tapering, transverse section, and longitudinal lines on each face, but has more numerous transverse lines which also are angulated in the middle. The specimen from Koudeveld Berg (80 S.A. Mus.) which the author † compared with *C. undulata* in 1904 has more numerous transverse lines than *C. albertensis*, and does not seem identical with the Bolivian form, as Kozłowski ‡ remarks.

* Ulrich, Neues Jahrb. f. Miner. Geol., Beil. Bd. viii, 1893, p. 31, t. iii, figs. 6, 6a; Knod, *ibid.*, Beil. Bd. xxv, 1908, p. 513, t. xxiv, figs. 1, 2; t. xxxi, fig. 3.

† Reed, Ann. S. Afr. Mus., vol. iv, pt. 6, p. 248, pl. xxxi, figs. 1, 1a.

‡ Kozłowski, *op. cit.*, 1923, p. 70, pl. vii, fig. 7.

Conularia Baini, Ulrich.

1893. *Conularia Baini* Ulrich, Neues Jahrb. f. Miner., Beil. Bd. viii, p. 36, t. iii, fig. 8.
 1906. *Conularia africana* Schwarz (pars), Rec. Albany Mus., vol. i, pt. 6, p. 362, pl. vii, fig. 14 (*non* 13, 15).
 1920. *Conularia Baini* Douglas, Quart. Journ. Geol. Soc., vol. lxxvi, p. 37, pl. i, fig. 2.
 1923. *Conularia Baini*, Kozłowski, Ann. Paléont., vol. xii, p. 68, pl. vii, fig. 4.

The short, broadly-pyramidal form, tapering at about 1 in 2-2½, which Ulrich separated off as *Con. Baini*, though it is usually included in *C. africana*, is represented in the Albany Museum by one of the specimens figured by Schwarz (116 Alb. Mus.) as *C. africana*. Kozłowski says that one of the distinguishing characters are the longitudinal lines, and Ulrich says that the transverse ribs are set with tubercles, though these have usually been rubbed off. Such is the case in one of the specimens (116 Alb. Mus.) in the Albany Museum, though it fails to show the longitudinal lines. The latter, however, show in places in a specimen (793 S.A. Mus.) from an unknown locality, and in a fragment (1478 Alb. Mus.) where not only these short transverse lines across the interspaces but also the small low tubercles or granules on the ribs are seen, particularly in the impress (117 Alb. Mus.) of the surface of the same specimen.

Dimensions (793 S.A. Mus.) :—

Length of fragment	.	.	.	37 mm.
Diameter at mouth	.	.	.	31 „
„ at end of fragment	.	.	.	12 „
Rate of tapering	.	.	.	1 in 2.

C. lata Hall *mut.*,* as described and figured by Clarke from the Grande Grève Limestone of Gaspé, has a similar shape and identical ornamentation, and perhaps Kozłowski's *Conularia* sp.† from Parana is identical with our Bokkeveld form. We may suspect that the imperfectly preserved form (88 Alb. Mus.), to which was attached ‡ the MS. name *C. pinchiniana* Salt., belongs to this species, but the ribs are coarser and more widely separated.

* Clarke, Mem. 9, New York State Mus., pt. 1, 1908, p. 144, pl. xi, figs. 6-9.

† Kozłowski, Ann. Paléont., vol. viii, 1913, p. 11, pl. xii, figs. 13, 14.

‡ Schwarz, *op. cit.*, p. 363, pl. vii, fig. 15.

Conularia gamkaensis sp. nov.

1904. *Conularia* cf. *acuta* Roemer, Reed, Ann. S. Afr. Mus., vol. iv, pt. 6, p. 249, pl. xxx, fig. 11 (75 S.A. Mus.).

This form is not identical with *C. ulrichana* Clarke, differing by the transverse position and laterally compressed oval shape of the tubercles which are set across the concentric ribs. The characters were described by me in 1904, and the shell seems to deserve a new specific name. As Kozłowski * pointed out, it does not agree with *C. acuta* Roemer nor with *C. ulrichana*, for the ornamentation and number of the ribs in the same space are different. A fine specimen in four pieces (2607 Alb. Mus.) from the same locality, Gamka Poort, mentioned by Schwarz (*op. cit.*, 1906, p. 363) as *C. cf. acuta*, occurs in the Albany Museum. In it the face preserved is gently concave; the concentric ribs are thick, continuous across the face, regularly and gently curved upwards, equidistant, not interrupted in the middle of the face, and they number 16-18 in 5 mm., but distally seem wider apart, as in the Cape Town specimen (75 S.A. Mus.). The tubercles which cross the ribs are of the nature of transverse rings which are close and equidistant and form scarcely-interrupted longitudinal series, for, as mentioned in the case of the Cape Town example, the grooves are crossed by their continuation from rib to rib.

Conularia ulrichana, Clarke.

- ? 1856. *Conularia africana* Sharpe (pars), Trans. Geol. Soc., ser. 2, vol. vii, p. 214, pl. xxvii, fig. 13c (1349 Brit. Mus.), *non cet.*
 1906. *Conularia africana* Schwarz (pars), Rec. Albany Mus., vol. i, pt. 6, p. 362, pl. vii, fig. 13 (1483, 15, 1479 Alb. Mus.).
 1913. *Conularia ulrichana* Clarke, "Foss. devon. Parana," p. 161, pl. viii, figs. 16-21.
 1923. *Conularia ulrichana* Kozłowski, "Foss. Dev. Bolivie," Ann. Paléont., vol. xii, p. 69.

There is a fine group of four or five examples of a species of *Conularia* on a slab (36 S.A. Mus.) in the South African Museum from an unknown locality, which show the characters of *C. ulrichana* Clarke rather than of *C. africana*, for the fine transverse narrow ribs, though having the same curvature and behaviour as the last-mentioned

* Kozłowski, *op. cit.*, 1923, p. 69.

species, possess a row of minute equidistant granules along their crest of equal size. It is also noticeable that towards the apex the transverse ribs, instead of being continuous across the median longitudinal line on each face, tend to be interrupted and to alternate, while the halves thus formed are straighter and meet at an obtuse angle instead of forming a continuous gentle curve. The specimen (11349 Brit. Mus.) which Sharpe figured as *C. africana*, but only in transverse section, shows similar minute tubercles on the transverse ribs, and there is a specimen from Ezelfontein with similar characters (E. 455) in the Stellenbosch Museum. Some of Schwarz's specimens which he referred to *C. africana* in the Albany Museum (1483 Alb. Mus.) may also be relegated to *C. ulrichana*, in which Kozłowski (*op. cit.*) includes Ulrich's *C. cf. acuta* Roemer, from Bolivia, but not the author's Bokkeveld shell, which was compared with it, but now has been recognised as distinct under the name *gamkaensis*.

Conularia Quichua, Steinmann and Döderlein.

- 1893. *Conularia Quichua* Ulrich, Neues Jahrb. f. Miner., Beil. Bd. viii, p. 34, t. iii, figs. 7a, b.
- 1897. *Conularia Quichua* Kayser, Zeitschr. deut. geol. Gesell., vol. xlix, p. 288, t. xi, figs. 1, 2.
- 1904. *Conularia Quichua* Reed, Ann. S. Afr. Mus., vol. iv, pt. 6, p. 248, pl. xxx, figs. 10, 10a (72 S.A. Mus.).
- 1905. *Conularia Quichua* Thomas, Zeitschr. deut. geol. Gesell., vol. lvii, p. 254, t. xii, figs. 19, 19a.
- 1908. *Conularia Quichua* Knod, Neues Jahrb. f. Miner., Beil. Bd. xxv, p. 515.
- 1913. *Conularia Quichua*, Clarke, "Foss. devon. Parana," p. 163.
- 1920. *Conularia Quichua*, Douglas, Quart. Journ. Geol. Soc., vol. lxxvi, p. 37, pl. i, fig. 3.
- 1923. *Conularia Quichua*, Kozłowski, Ann. Paléont., vol. xii, p. 69, pl. vii, fig. 5.

Kozłowski does not think that the Bokkeveld shell which I attributed to *C. Quichua* is identical with the South American form on which the species was founded, but I see no adequate reason for separating them. Another specimen (15 Brit. Mus.), from the Cedarberg, has been recognised in the British Museum. Douglas (*op. cit.*) is of opinion that the Taya Taya beds of Peru, in which *C. Quichua* occurs, may be correlated with the lower part of the Middle Devonian (Hamilton Group) of North America.

Diaphorostoma Baini (Sharpe).

- 1856 *Littorina*? *Baini* Sharpe, Trans. Geol. Soc., ser. 2, vol. vii, p. 213, pl. xxvii, figs. 11, 12 (11346, 11347 Brit. Mus.).
- ? 1875. *Holopea furmanianum* Hartt and Rathbun, Ann. New York Lyceum Nat. Hist., vol. xi, p. 115.
- ? 1899. *Diaphorostoma furmanianum*, Clarke, "Devon. Mollusca of Para," Archiv Mus. Nac. Rio de Janeiro, vol. x, p. 32, pl. iv, figs. 10-13.
1904. *Holopea Baini* Reed, Ann. S. Afr. Mus., vol. iv, pt. 6, p. 245.
- ? 1908. *Diaphorostoma furmanianum* Knod, Neues Jahrb. f. Miner. Geol., Beil. Bd. xxv, p. 510.
- ? 1913. *Diaphorostoma allardycei* Clarke, "Foss. devon. Parana," Mon. Serv. Geol. Miner. Brasil, vol. i, p. 175, pl. ix, figs. 8-10.
- ? 1923. *Diaphorostoma* cf. *furmanianum* Kozłowski, Ann. de Paléont., vol. xii, p. 76, pl. viii, figs. 21, 21a.

There does not seem to be any sufficient reason for separating the three species, *D. Baini*, *D. allardycei*, and *D. furmanianum* from South Africa, the Falkland Isles, and South America. Specimens (14444 Brit. Mus.) from the Gydo Pass show transitional shapes with variation in the apical angle, and I have compared specimens in the Albany Museum from the Falkland Islands with them.

Diaphorostoma? sp.

1904. *Diaphorostoma*? sp. Reed, Ann. S. Afr. Mus., vol. iv, pt. 6, p. 245 (161, 162, 163 S.A. Mus.).

The original specimens from Gamka Poort are very crushed and imperfect, and their true affinities and even generic position are uncertain, but it seems much like *Pleurotomaria* sp. β * which Thomas describes from Argentina.

Platyceras bokkeveldense sp. nov.

(Pl. VII, fig. 1.)

Shell globose, obliquely ovoid, subheliciform, low, composed of 3-4 subcircular whorls loosely coiled, but in contact the upper 2-3 whorls very small and forming low apex, the body whorl large, forming greater part of shell, rapidly expanding to large subcircular campanulate mouth. Surface with faint traces of concentric encircling lines.

* Thomas, Zeitschr. deut. geol. Gesell., vol. lvii, 1905, p. 254, t. xii, figs. 18, 15a.

Dimensions (2442 S.A. Mus.) :—

Length	30 mm.
Height	c. 16 „
Width of mouth (max.)	20 „

Remarks.—There is only one specimen (2442 S.A. Mus.) of this species, and it consists of an internal cast from Koudeveld Berg in the South African Museum. We may compare it with *Platyceras Gebhardi* Conrad * of the Oriskany Sandstone rather than with any species of *Platyceras* from Bolivia such as Knod † and Kozłowski ‡ have described.

Loxonema capense, Reed.

1904. *Loxonema* sp. Reed, Ann. S. Afr. Mus., vol. iv, pt. 6, p. 244, pl. xxx, fig. 8 (164, 163 S.A. Mus.).

1908. *Loxonema capense*, Reed, *ibid.*, vol. iv, pt. 8, p. 405.

This species, which was described but not named in 1904, had the name *capense* subsequently (1908) suggested for it. Much better specimens have now come under my notice (7173 S.A. Mus.), and the very slightly inflated whorls and scarcely sunken sutures distinguish it from the other Bokkeveld species. It is allied to *L. glabrum* Kozł. § of the Bolivian Devonian, as Kozłowski remarks, but its rate of tapering is slower. In the Kimberley Museum internal casts from Paarde Bont, Oudtshoorn district (3287 Kimb. Mus.), exhibit the typical characters.

Loxonema zwartbergense sp. nov.

(Pl. VII, figs. 4, 4a.)

Shell turreted, slender, slowly tapering, composed of many (? 8–10) whorls; apical angle 20° – 25° ; whorls gently convex, about $1\frac{1}{2}$ times as wide as high; suture line rather deep, inclined at about 75° to axis; subsutural band very narrow. Surface of whorls crossed by fine granulated lines (?) meeting the sutures nearly at right angles.

* Hall, Palaeont. New York, vol. iii, 1859, p. 312, pl. lvi, figs. 5, 6, 7, 9; p. 474, pl. cxvii, figs. 1–10. Ohern and Maynard, Maryland Geol. Surv., Lower Devonian, 1913, p. 470, pl. lxxx, figs. 2–9.

† Knod, Neues Jahrb. f. Miner., Beil. Bd. xxv, 1908, p. 511, t. xxiii, figs. 8, 8a, b.

‡ Kozłowski, *op. cit.*, 1923, p. 75, t. viii, figs. 19, 19a.

§ *Ibid.*, p. 74, t. x, fig. 13.

Remarks.—This shell (624 S.A. Mus.) from the Zwartberg Pass, is undoubtedly distinct from *L. capense*, the whorls being more swollen and the suture lines more sunken, so that it seems to deserve a distinctive name. It is rather a common form and seems much like the shell occurring in the Bolivian Devonian which Knod * considers allied to *L. attenuatum* Hall, but it is less elongated and the suture line makes a larger angle with the axis. Our specimen (624) consists of an external impression and internal cast of the 5 basal whorls, measuring about 23 mm. in length. The diameter of the basal whorl is about 8 mm., and its height nearly 6 mm. In the British Museum (G. 1711) there are examples from Keurbooms River.

We may compare it with the American species *L. welleriana* Will. and Breg.† from the Chapman Sandstone.

Loxonema cf. *gregarium*, Knod.

There is one imperfect specimen (5421 S.A. Mus.) of a turriculate gastropod showing the 4 lower whorls of the shell, including the basal one on which the ornamentation is preserved on part of the surface. The apical angle, sutural angle, subsutural band, and proportions of the whorls are indistinguishable from *L. capense*, so far as the state of preservation of the specimen allows us to determine the characters, but the ornamentation consists of transverse, very slightly arched, raised, equidistant, thread-like lines, much as in *Loxonema funatum* Roemer, with which a form ‡ from the Chapman Sandstone of Maine has been compared. But *L. gregaria* § Knod, from the Icla Shales of Bolivia, is more closely allied, and our Bokkeveld specimen may be at any rate compared with it, though it is too poor for a precise description. Knod considers that his species resembles *L. delphicola* Hall, of the Hamilton Group, and we may also mention *L. hamiltoniae* Hall,|| of the same formation.

Our specimen was collected at Roode Hoogbe Kloof, between Montagu and Triangle.

* Knod, *op. cit.*, 1908, p. 509, t. xxiii, fig. 4.

† Williams and Breger, Prof. Paper 89, U.S. Geol. Surv., 1916, p. 279, pl. xiii, figs. 2, 3, 5.

‡ Clarke, Mem. 9, New York State Mus., pt. 2, 1909, p. 102, pl. xxiii, figs. 25 and 26.

§ Knod, Neues Jahrb. f. Miner. Geol., Beil. Bd. xxv, 1908, p. 508, t. xxiii, figs. 3, 3a.

|| Prosser and Kindle, Maryland Geol. Surv., 1913, Devonian, p. 294, pl. xxxvi, figs. 16-19.

Palaeoscurria Sharpei sp. nov.

(Pl. VII, figs. 5, 5a, b.)

1856. *Orbicula Baini*, Sharpe (pars), Trans. Geol. Soc., ser. 2, vol. vii, p. 210, pl. xxvi, fig. 20 (11332 Brit. Mus.) *non* figs. 21–23.

? 1893. *Discina Baini*, von Ammon, Zeitschr. Gesell. Erdkunde, vol. xxviii, p. 359, fig. 4.

Shell subcircular to subovate, capuliform; apex eccentric, directed backwards, situated at one-sixth (or less) the diameter from posterior edge, with steep or nearly vertical slightly-concave slope below it; anterior slope convex, rounded; maximum height of shell in front of apex. Surface marked with strong concentric unequal growth-striae, crowded together on posterior slope and more widely spaced anteriorly, all crossed by very delicate close radial lines.

Dimensions (B. 45501 Brit. Mus.):—

Length	.	.	.	20.0 mm.
Diameter	.	.	.	21.0 „
Height (max.)	.	.	.	9.0 „

Remarks.—The first specimen (11332 Brit. Mus.) from the Bokkeveld Beds of Gydo Pass which Sharpe figured as *Orbicula Baini* is quite distinct from all the others and from the generally-accepted type of this species. But his definition agrees better with it than with them, for he describes it as “testâ ovato-circulari, depresso-conicâ, apice excentricâ, concentrica subrugatâ, radiatim subtilissimè striatâ.” He does not, however, show the radial striae in his figure, though they show in the specimen, and the shell should be described as capuliform rather than conical, the arched back and slightly depressed backwardly directed apex with steep posterior slope below it being marked features.

Von Ammon (*op. cit.*) has apparently found the same kind of shell in Brazil. In the true *O. Baini* the concentric lines are sharp, equal, equidistant, and not crowded together posteriorly, the apex is sharper and more central, the whole shell is conical, and there are no external radial striae, the only radial lines present belonging to an inner layer of the shell, and only becoming visible in those places where the outermost concentrically ridged layer has been removed or broken.

In my previous description of the Bokkeveld fossils in 1903 (Ann. S. Afr. Mus., vol. iv, pt. 4, p. 168), the distinction between these two types of shells was overlooked. But we must certainly remove the above-described species from *O. Baini*, and, moreover, not only put

it in another species and genus, but regard it as a gastropod allied to *Palaeoscurria gibbosa* (Barr) as described by Perner * from Stage F. f. 2 in Bohemia. The apex in both the specimens in the British Museum is broken. The shell figured here is from the Gydo Pass, as is also Sharpe's example.

Metoptoma capense, Reed.

1908. *Metoptoma capense* Reed, Ann. S. Afr. Mus., vol. iv, pt. 8, p. 385, pl. xlvii, figs. 1, 2 (1178 S.A. Mus.).

No further examples of this shell have been observed in any of the collections. The poorly preserved specimens bearing this name in the Albany Museum seem to have been erroneously identified.

Pleurotomaria aff. *Kayseri*, Ulrich.

1904. *Pleurotomaria* aff. *Kayseri* Reed, Ann. S. Afr. Mus., vol. iv, pt. 6, p. 241, pl. xxx, fig. 3 (70f S.A. Mus.).
1913. *Pleurotomaria Kayseri* Clarke, "Foss. devon. Parana," p. 164, pl. ix, fig. 12.

There is no further example of this shell from the Bokkeveld Beds, but Knod † again records the species from Bolivia, and Clarke from Brazil. Probably it belongs to the subgenus *Eotomaria*, and is allied to *E. delia* (Billings).‡

Bellerophon (*Plectonotus*) *fraternus*, Reed.

- ? 1906. *Bellerophon Reissi* Schwarz, Rec. Albany Mus., vol. i, pt. 6, pl. viii, figs. 1, 1a (128 Alb. Mus.).
1908. *Bellerophon* (*Plectonotus*) *fraternus* Reed, Ann. S. Afr. Mus., vol. iv, pt. 8, p. 386, pl. xlvii, figs. 3, 3a, 4 (25 (1180) S.A. Mus.).

As previously remarked, the resemblance of this species to *B. (Pl.) Salteri* Clarke, of the Brazilian Devonian is close. *B. ("Bucaniella") Dereimsi* Knod is less closely allied. The shell which Schwarz identified with *B. Reissi* Clarke § is more probably referable to our *B. fraternus*. Kegel || has described and figured a European species from the Lower Devonian of Germany under the

* Perner, Syst. Silur. Boheme, Gastropoda, vol. iv, t. i, 1903, p. 50; t. ii, 1907, pl. civ, figs. 18-20.

† Knod, *op. cit.*, 1908, p. 508.

‡ Clarke, Mem. 9, New York State Mus., pt. 1, 1908, p. 151, pl. xvi, figs. 6-8, 17.

§ Clarke, Archiv Mus. Nac. Rio de Janeiro, vol. x, 1899, p. 37, pl. iii, figs. 7-9.

|| Kegel, Abh. k. preuss. geol. Landesanst., N.F., Heft 76, 1913, p. 45, t. iii, fig. 1.

name *B. (Bucaniella) regius* which much resembles our Bokkeveld shell. Williams and Breger* refer the closely-similar trilobed American shells from the Chapman Sandstone of Maine to Sowerby's Silurian species *B. trilobatus*, but this name requires a more restricted application.

Bellerophon (Plectonotus) cf. Dereimsi (Knod).

1904. *Bellerophon (Bucaniella) aff. trilobatus*, Reed, Ann. S. Afr. Mus., vol. iv, pt. 6, p. 242, pl. xxx, fig. 5 (213 S.A. Mus.).
 1908. *Bucaniella Dereimsi*, Knod, Neues Jahrb. f. Miner. Geol., Beil. Bd. xxv, p. 506, t. xxii, figs. 4, 5.
 1913. *Plectonotus (Bucaniella) Dereimsi*, Clarke, "Foss. devon. Parana," p. 165, pl. ix, figs. 13-17.

This species, which was founded by Knod on internal casts from Bolivia, but has been subsequently described from Brazil by Clarke, is closely allied to *B. fraternus*, but has deeper revolving furrows and a relatively wider and more rapidly expanding median lobe on the back. The revolving lines which ornament the exterior, as Clarke shows in his figures of specimens from Ponta Grossa, are preserved in some of the examples from the Bokkeveld Beds of Gydo Pass (213) in the South African Museum, but usually we have only internal casts with which to deal. *Pl. Derbyi* Clarke,† from Brazil and Maine,‡ seems to be an allied species, but has a much less expanded mouth, and therein resembles *B. (Pl. ?) gaspensis* Clarke§ from the Grande Grève Limestone of Gaspé. It should be mentioned that Clarke's Brazilian examples of *B. Dereimsi* seem to differ from Knod's type from Bolivia, and Clarke himself notices several points of difference, and we may doubt if they really belong to the same species.

Bellerophon (Plectonotus) cf. laticarinatus (Knod).

- ? 1904. *Bellerophon (Plectonotus) cf. Reissi* Reed, Ann. S. Afr. Mus., vol. iv, pt. 6, p. 243, pl. xxx, figs. 6, 6a (107 S.A. Mus.).
 1905. *Tropidocyclus cf. Gilletianus*, Thomas, Zeitschr. deut. geol. Gesell., vol. lviii, p. 253, t. xii, figs. 13a, b.
 1906. *Bellerophon trilobatus* Schwarz, Rec. Alb. Mus., vol. i, pt. 6, pl. viii, fig. 2 (139 Alb. Mus.).

* Williams and Breger, *op. cit.*, 1916, p. 206, pl. xiv, figs. 1, 1a, b, 12, 13, 17-19, 28.

† Clarke, Archiv Mus. Nac. Rio de Janeiro, vol. x, 1899, p. 38, t. iii, figs. 14-18.

‡ Clarke, Mem. 9, New York State Mus., pt. 2, 1909, p. 98, pl. xii, figs. 17-19; pl. xxiv, figs. 1-11.

§ *Ibid.*, pt. 1, 1908, p. 154, pl. xvii, figs. 17, 18.

- ? 1908. *Bellerophon* (*Tropidocyclus*) cf. *gilletianus*, Reed, Ann. S. Afr. Mus., vol. iv, pt. 8, p. 385.
 1908. *Bucaniella laticarinata* Knod, Neues Jahrb. f. Miner. Geol., Beil. Bd. xxv, p. 505, t. xxii, figs. 6, 6a.
 1913. *Bucaniella laticarinata*, Kozłowski, Ann. Paléont., vol. viii, p. 10, pl. xii, figs. 12, 12a.

Knod's species was founded on internal casts, but it is probable that the Brazilian *B. hapsideus* Clarke * is closely allied. A number of small specimens of this type occur in the Albany Museum (Nos. 124, 129, 126, 140, 141, 139) from the Warm Bokkeveld, and others in the South African Museum (3794 S.A. Mus.) from Laken Vlei, Ceres, show traces of ornamentation like *B. hapsideus*. Williams and Breger † refer the true *B. gilletianus* and its allies to *Tropidodiscus*.

Bellerophon (*Plectonotus*) *quadrilobatus*, Salter.

1856. *Bellerophon quadrilobatus* Salter, Trans. Geol. Soc., ser. 2, vol. vii, p. 214, text-figs. 1, 2 (11351 Brit. Mus.).
 1904. *Bellerophon quadrilobatus* Reed, Ann. S. Afr. Mus., vol. iv, pt. 6, p. 242.
 ? 1913. *Bellerophon quadrilobatus* Salter ? Clarke, "Foss. devon. Parana," pl. ix, fig. 11.

Clarke (*op. cit.*) has figured a specimen from West Falkland which he doubtfully identifies with Salter's South African species. It is clear that this species belongs to the same group as *B. fraternus*, *B. Dereimsi*, *B. laticarinatus*, etc., which are characteristic of the Lower Devonian in the southern hemisphere.

The type specimen (11351) in the British Museum is from the Warm Bokkeveld, and shows the quadrilobation of the dorsum more distinctly than represented in Salter's text-figures (*op. cit.* p. 214, figs. 1, 2). There is a specimen (27 S.A. Mus.) from Gamka Poort in the South African Museum which also shows the typical characters, but this species does not seem common.

Bellerophon (*Plectonotus* ?) aff. *Reissi*, Clarke.

1904. *Bellerophon* aff. *Salteri* Clarke, Reed, Ann. S. Afr. Mus., vol. iv, pt. 6, p. 243, pl. xxx, figs. 7, 7a (108 S.A. Mus.).

The true reference of this shell is uncertain. The presence of a

* Clarke, *op. cit.*, 1913, p. 166, pl. ix, figs. 1-5.

† Williams and Breger, *op. cit.*, p. 272.

broad revolving peripheral band, such as Knod (*op. cit.*) shows in his *Bucaniella Dereimsi* and Clarke in his *Plectonotus Derbyi*,* seems sufficient to mark it off from the true *B. Salteri*. As Clarke states, "differing conditions of preservation have produced differing opinions as to the presence of a slit band," and Meek, Koken, Knod, and Clarke do not agree about its presence in many of these apparently allied species. In shape and weak trilobation our shell seems more like *B. Reissi* Clarke † than *B. Salteri*, but I am doubtful about its relationships.

Bellerophon (Patellostium) africanoides sp. nov.

(Pl. VII, figs. 6, 6a, b.)

Shell of few whorls ($2\frac{1}{2}$), high, broad, strongly convex, rapidly expanding in width but more slowly in height; spire small; whorls not closely enrolled, but in contact; umbilicus deep, open, with sharply-rounded edges. Outer whorl with broad rounded dorsum, wide transversely expanded subelliptical mouth having a broad shallow open median emargination forming a very weak sinus in the dorsal lip (which is not reflexed); lateral lips much expanded, simple and not reflexed; lower lip reflexed. Submarginal internal thickening on dorsal lip (forming a concentric groove with a median sinus on internal cast). No trace of slit-band.

Dimensions (14 Cape Univ.):—

Height of shell	.	.	32 mm.
Width of mouth	.	.	38 mm.
Height of mouth	.	.	c. 24 mm.

Remarks.—We have only one internal cast of this species and it is from an unknown locality, but it is in good preservation. It is preserved in the collection of the University of Cape Town (14), and is undoubtedly distinct from any previously described from the Bokkeveld Beds. We may especially compare it with *B. (Patellostium) revolvens* Will. and Breg.,‡ of the Moose River Sandstone, Maine, which they consider to be similar to *B. Freitasi* Clarke,§ from Brazil. *B. (Ptomatis) Moreirai* Clarke,|| from Ponta Grossa, seems also closely allied to our species.

* Clarke, *Archiv Mus. Nac. Rio de Janeiro*, vol. x, 1890, p. 38, pl. iii, figs. 14–18.

† *Ibid.*, p. 37, t. iii, figs. 7–9.

‡ Williams and Breger, *op. cit.*, 1916, p. 265, pl. xiv, figs. 14, 15, 20, 27.

§ Clarke, *op. cit.*, 1899, p. 35, pl. iii, fig. 22.

|| Clarke, *op. cit.*, 1913, p. 173, pl. ix, figs. 18–20.

Bellerophon (*Tropidodiscus*) cf. *globosus*, Knod.

There is a small *Bellerophon* in the Bain Collection in the Albany Museum from the Warm Bokkeveld, which has a high rounded parabolic or subangular dorsum; the outer whorl slowly expands in width but more rapidly in height, and completely envelops the inner whorls; the umbilicus is small, is situated at about one-third the height, and has a rectangular edge and steep descent. There is no sign of trilobation, and it seems that the shell much resembles the Argentine one which Kayser * thought allied to *B. Murchisoni* D'Orb., but to which Knod † gave the new specific name *globosus*, which is an unfortunate choice as the shell is the reverse of globose.

Dimensions :—

Height of shell	18.0 mm.
Antero-posterior diameter	c. 12.0 mm.
Transverse diameter near mouth .	c. 11.0 mm.
Height of umbilicus from base . .	6.5 mm.

Remarks.—The species from the Chapman Sandstone described as *Tropidodiscus obex* Clarke ‡ is probably allied, and *Tropidocyclus antarcticus* Clarke § from the Falkland Isles may also be compared.

Bellerophon cf. *morganianus*, Hartt and Rathbun.

1904. *Bellerophon* cf. *morganianus* Reed, Ann. S. Afr. Mus., vol. iv, pt. 6, p. 241, pl. xxx, figs. 4, 4a (110 S.A. Mus.).

No further example of this type of *Bellerophon* has been found. Its large expanded mouth and fine dorsal band suggest that it is rather more allied to *Bellerophon plenus* Billings, as figured by Clarke || from the Grande Grève Limestone of Gaspé, than to *B. morganianus* Hartt and Rathbun, which is characterised by the flattening of the inner portion of the body whorl. ¶ The Argentine shell which Thomas ** figured as *Ptomatis* sp. appears to be much like our specimen.

* Kayser, Zeitschr. deut. geol. Gesell., vol. xlix, 1897, p. 287, t. x, fig. 9.

† Knod, Neues Jahrb. f. Miner. Geol., Beil. Bd. xxv, 1908, p. 503, t. xxii, figs. 1-2b.

‡ Williams and Breger, *op. cit.*, p. 270, pl. xiv, figs. 3-10, 16, 21.

§ Clarke, *op. cit.*, 1913, p. 174, pl. ix, fig. 7.

|| Clarke, Mem. 9, New York State Mus., pt. 1, 1908, p. 153, pl. xvii, figs. 25-28.

¶ Clarke, Archiv Mus. Nac. Rio de Janeiro, 1899, p. 34, pl. iii, figs. 1-4.

** Thomas, Zeitschr. deut. geol. Gesell., vol. lvii, 1905, p. 251, t. xii, figs. 12, 12a.

Orthoceras bokkeveldense, Reed.

1904. *Orthoceras bokkeveldense* Reed, Ann. S. Afr. Mus., vol. iv, pt. 6, p. 239, pl. xxx, fig. 2 (172 S.A. Mus.).

Knod * considered Ulrich's *Orthoceras* sp. γ from Bolivia as identical with *O. bokkeveldense*, and if so *O. Ulrichi* Kozl.,† which is the name proposed for it by Kozłowski, is likewise, but Kozłowski denies this identification because the siphuncle is central. *O. Steinmanni* Kozl.,‡ also from Bolivia, which is said to be closely allied to *O. Ulrichi*, may also be compared.

Orthoceras gamkaense, Reed.

1904. *Orthoceras gamkaensis* Reed, Ann. S. Afr. Mus., vol. iv, pt. 6, p. 239, pl. xxx, figs. 1, 1a (177, 178 S.A. Mus.).

Kozłowski § has recently compared a Bolivian form with this species, and it is probable that they are identical, the slight want of circularity in section in my original specimens being due to distortion. Clarke || in 1913 had also compared a Brazilian specimen with it.

Orthoceras (Spyroceras ?) rex, Schwarz.

1906. *Orthoceras rex* Schwarz, Rec. Albany Mus., vol. i, pt. 6, p. 381, pl. viii, fig. 7 (2812 Alb. Mus.).

In the concentric annulation and other characters of this species we see a great resemblance to *O. san-bartolomense* Kozl.¶ of the Devonian of Bolivia: indeed it may be identical. It is less like the large variety of *Kionoceras rhysum* Clarke ** from the Grande Grève Limestone of Quebec, and it has no longitudinal ribs.

There is only the one poor specimen (2812 Alb. Mus.) of this species which was found on Keurbooms River heights, Knysna. Schwarz does not describe, though he names the species, so that some remarks on its characters may be here given. The shell is annulated, and has gently concave spaces between the rings which are horizontal, low, and situated at about two-fifths or one-third of the diameter apart. The septa do not show distinctly, but seem to coincide with the rings. The specimen is crushed, but the rate of tapering was undoubtedly very slow (1 in 16–17, as Schwarz states). Probably it belongs to

* Knod, *op. cit.*, 1908, p. 502.

† Kozłowski, *op. cit.*, 1923, p. 63, pl. vii, fig. 8.

‡ *Ibid.*, p. 64, pl. vii, fig. 10.

§ *Ibid.*, p. 63, pl. vii, fig. 9.

|| Clarke, *op. cit.*, 1913, p. 159, pl. viii, fig. 10.

¶ Kozłowski, Ann. Paléont., vol. xii, 1923, p. 65, pl. vii, figs. 14, 15.

** Clarke, Mem. 9, New York State Mus., pt. 1, p. 142, pl. xiii, figs. 4, 5.

the subgenus *Spyroceras* Hyatt, of which *O. crotalum* (Hall) of the Hamilton Formation * is a well-known example.

Tentaculites Baini, Reed.

1904. *Tentaculites Baini* Reed, Ann. S. Afr. Mus., vol. iv, pt. 6, p. 246, pl. xxx, fig. 9 (181 S.A. Mus.).

No further example of this species has been found. Clarke † does not think that it is justifiable to compare it with his *T. jaculus*, but the author pointed out its resemblance in some respects to *T. eldredgianus* Hartt and Rathbun, and it may further be stated that it bears considerable similarity to *T. Cartieri* Clarke, ‡ from the Gaspé basin, Quebec.

Tentaculites crotalinus, Salter.

1904. *Tentaculites crotalinus* Reed, Ann. S. Afr. Mus., vol. iv, pt. 6, p. 245 (for earlier references).
 1913. *Tentaculites crotalinus* Clarke, "Foss. devon. Parana," p. 86, pl. viii, figs. 1-4.
 1913. *Tentaculites crotalinus* Kozłowski, Ann. Paléont., vol. viii, p. 11, pl. xii, figs. 15, 15a.

The relations of this species were discussed by me in 1904, and Clarke has more recently described it in connection with the South American fauna, recording it from Brazil and the Falkland Islands, while Kozłowski figures it from Bolivia. It is widely distributed in the Bokkeveld Beds.

Tentaculites desuetus sp. nov.

(Pl. VII, figs. 9, 10.)

Shell elongated, conical, tapering slowly at about 1 in 8 or 9 to apex, annulated for the greater part of its length with sharp regular equidistant rings, separated by concave interspaces of 3-4 times the width, but with the apical portion of the shell devoid of rings and smooth. Interspaces ornamented with fine equidistant regular longitudinal lines.

Dimensions (135 Cape Univ.): Length, c. 26.0 mm.; Diameter at mouth, c. 3.5 mm.

Remarks.—There is a good specimen of this shell from Keurbosch (135) in the collection of the University of Cape Town, though it is

* Prosser and Kindle, Maryland Geol. Surv., Mid. Devonian, 1913, p. 314, pl. xli, figs. 1-5.

† Clarke, *op. cit.*, 1913, p. 89.

‡ Clarke, Bull. 107, New York State Mus., 1907, p. 174, text-figs.

somewhat crushed and flattened; the smooth apical portion measures in this case nearly one-third of the total length, but usually it is shorter in other examples from this locality (291, 293 Cape Univ.). Another group of specimens (446 Pret. Mus.) from Tunnel Siding, near Triangle, is in the Pretoria Museum. The rings are not oblique to the axis nor at unequal distances apart, as in *T. Stübeli* Clarke,* from Brazil and Bolivia, which it otherwise closely resembles in having the apical portion smooth and not annulated. The longitudinal lineation of the interspaces which is rarely preserved is another point of difference. The Helderbergian species, *T. elongatus* Hall, which also occurs in the Oriskany, is described by Clarke † as losing its annulations towards the apex, as in our Bokkeveld form.

Serpulites sica, Salter.

1856. *Serpulites sica* Salter, Trans. Geol. Soc., ser. 2, vol. vii, p. 22, pl. xxv, fig. 19.

1913. *Serpulites sica* Clarke, "Foss. devon. Parana," p. 86, pl. xxvi, fig. 15.

Clarke (*op. cit.*) has described this Bokkeveld species from Brazil, but can add nothing to the original description. Probably the fossil from the Chapman Sandstone, Maine, described by Williams and Breger ‡ as *Trachyderma* (? *Gyrchnites*) *speciosa* sp. nov. is congeneric and an allied species.

TRILOBITA.

Proetus malacus, Lake.

(Pl. XI, fig. 3.)

? 1888. *Praetus* (sic) *ricardi* Schenck, Peterm. Mitth., vol. xxxiv, p. 227.

1904. *Proetus malacus*, Lake, Ann. S. Afr. Mus., p. 213, pl. xxv, fig. 10 (45 S.A. Mus.).

1906. *Proetus ricardi* Schwarz, Rec. Albany Mus., vol. i, pt. 6, p. 390, pl. x, figs. 5, 5a.

Lake's type specimen (45 S.A. Mus.) is not in a very good state of preservation, and it is therefore satisfactory to find a complete, partly-enrolled example from the Cockscomb Mountains in the Bloemfontein Museum, from which several additional details may be

* Clarke, Archiv Mus. Nac. Rio de Janeiro, vol. x, 1899, p. 43, pl. iv, figs. 24-28; Knod, Neues Jahrb. f. Miner. Geol., Beil. Bd. xxv, 1908, p. 559.

† Clarke, Mem. 3, New York State Mus., 1900, p. 27, pl. iii, figs. 8-12.

‡ Williams and Breger, *op. cit.*, 1916, p. 19, pl. xxii, fig. 20.

given. The glabella has three pairs of furrows on it; the first pair are short, horizontal, slightly arched, scarcely reaching the axial furrow, and situated at about one-third the length of the glabella from the front end; the second pair are more oblique and longer, extending more than one-third across the glabella, and are situated at about one-half its length; the third pair are more oblique and curve back to meet the meso-occipital furrow separating off the basal lobes, which are larger than the others, and triangular in shape, with their base equal to one-third the width of the glabella. The glabella is sub-urceolate, very broad and short, widening rather rapidly towards the base behind the second lateral furrows. The eyes are very large, closely placed against the sides of the glabella, and reach from the first lateral furrows to its base. As Lake states, the axial furrows are weak, but particularly so in crossing the eye-lobes. The genal angles are produced back into broad, flattened, rapidly-tapering genal spines, reaching back to the sixth or seventh thoracic pleurae. The meso-occipital furrow is strong, deeply impressed, and narrow, and is slightly arched forward in the middle. The pleuro-occipital furrow is wide and shallow. The marginal and pleuro-occipital furrows meet at a very acute angle at the base of the genal spines, and are produced back to their tip, grooving the spines for their whole length.

The glabella reaches the broad, flattened, or slightly-concave border in front and descends rather steeply to it.

The thorax has 9 segments and is convex and wider than the pleural lobes, as Lake says, and the pleurae have been described by him.

The pygidium is large and possesses 7 rounded elevated unfurrowed pleurae, which are separated by interpleural grooves as wide as the pleurae, and they reach the narrow raised rounded border, which is marked off by a wide marginal furrow. The whole surface of the trilobite is covered with rather coarse granulation.

Dimensions :—

Length of head-shield	.	.	15.0 mm.
Width	„	„	30.0 „
Length of glabella	.	.	10.5 „
Width	„	„ at base	11.5 „
„	„	„ at front	9.0 „
Length of thorax	.	.	c. 18.0 „
„ of pygidium	.	.	c. 15.0 „
Width	„	.	25.0 „
„ of axis of pygidium	.	.	10.0 „

Affinities.—The species may be referred to the subgenus *Euproetus*, established by Richter * in 1913, and it seems allied to *Proetus conradi* Hall † of the early Devonian of North America, and especially to *Pr. phocion* Billings, ‡ from the Grand Grève Limestone of Gaspé.

Proetus hexensis sp. nov.

(Pl. VII, fig. 8.)

Pygidium broadly semicircular, very slightly arched; margin entire. Axis broadly conical, gently convex, tapering rather rapidly to blunt tip, not reaching edge, annulated for whole length very indistinctly by 8-9 low, broad, flattened, very faintly-defined rings, of which only the anterior 2-3 have sharp intersegmental furrows. Pleural lobes slightly convex, with half pleura on front margin having obtusely-angular, well-marked fulcrum at about half its width, and strong sharp furrow behind it; rest of pleural lobes composed of 5 very flat low pleurae, of which only the first 2-3 are distinct, being separated by narrow sharp furrows not reaching border, and having a faint furrow on their surface parallel and close to anterior edge. Border of pygidium slightly flattened, very feebly marked off from pleural lobes. Surface of pygidium minutely granulated.

Dimensions (H 176 Stell. Mus.):—

Length of pygidium	.	.	16.0 mm.
Width „ „	.	.	30.0 „
Length of axis	.	.	14.0 „
Width „ „ at front	.	.	11.0 „

Remarks.—The specimen above described is from De Doorns and is in the Stellenbosch Museum. A smaller example (3889 S.A. Mus.) in the South African Museum comes from Uitkomst, Ceres. This type of pygidium is more like that of *Proetus Rowi* (Green) § of the Hamilton Formation than *Pr. malacus*, but we may observe a resemblance in it to *Phacops? pullinus* Clarke || from Brazil, which its author thought might belong to the genus *Proetus*.

* Richter, Abh. Senckenberg. Naturforsch. Gesell., Bd. xxxi, 1913, p. 352; *id.*, Centralbl. f. Min., etc., Jahrg. 1918, pp. 64-70.

† Hall, Palaeont. New York, vol. vii, 1888, p. 89, pl. xx, fig. 9; pl. xxi, figs. 27, 28; pl. xxii, fig. 4; Clarke, Mem. 3, New York State Mus., 1900, p. 25, pl. ii, figs. 11-16.

‡ Clarke, Mem. 9, New York State Mus., pt. i, 1908, p. 135, pl. ix, figs. 14-16.

§ Hall, Palaeont. New York, vol. vii, 1888, p. 119, pl. xxi, figs. 2-6, 24-26, pl. xxiii, figs. 20-29.

|| Clarke, Archiv Mus. Nac. Rio de Janeiro, vol. ix, 1890, p. 20, pl. i, fig. 12.

Cyphaspis Dereimsi, Kozłowski.

(Pl. X, fig. 10.)

1923. *Cyphaspis Dereimsi* Kozłowski, "Faune Devon. Bolivie,"
Ann. de Paléont., vol. xii, p. 61, pl. iv, figs. 15, 16, 17, 17a.

One nearly complete individual possessing the characteristic features of the Bolivian *Cyphaspis Dereimsi* Kozłowski, was obtained by me in the road-cutting between De Doorns and Tunnel. The head-shield and thorax are excellently preserved both as the cast and impression, and the former shows well the glabella with its pair of basal lobes, the convex preglabellar area and wider border, as well as the eyes, facial suture, and genal angle on one side. The pygidium is missing. Kozłowski compares this species with *C. minuscula* Hall,* of the Onondaga and Oriskany Groups, but it is certainly distinct.

No example of this genus has been previously discovered in the Bokkeveld Beds, and this occurrence is another valuable piece of evidence of the close similarity of the South American and South African Devonian faunas.

Dimensions :—

Length of head-shield	.	.	11.0 mm.
Width	..	..	24.0 mm.
Width of glabella	.	.	8.0 mm.

Dalmanites (Anchiopella) africanus (Salter) sens. restr.

(Pl. VIII, figs. 1, 1a-c.)

1856. *Phacops (Cryphaeus) africanus* Salter (pars), Trans. Geol. Soc., ser. 2, vol. vii, p. 218, pl. xxv, fig. 1 (11295 Brit. Mus. ?), fig. 5 (11287 Brit. Mus.) (*non cet.*).
1904. *Phacops cristagalli* Lake (*non* Woodward), Ann. S. Afr. Mus., vol. iv, pt. 4, p. 205, pl. xxiv, fig. 5 (27 S.A. Mus.).
1904. *Phacops africanus* Lake, *ibid.*, p. 205, pl. xxiv, fig. 6 (67 S.A. Mus.), fig. 7 (27 S.A. Mus.), fig. 8 (222 S.A. Mus.).
1906. *Phacops acacia* Schwarz, Rec. Albany Mus., vol. i, pt. 6, p. 398, pl. x, figs. 4, 4a (2124 Alb. Mus.).
1913. *Dalmanites (Mesembria) acacia*, Clarke (pars), "Foss. devon. Parana," p. 116, pl. v, figs. 7, 8 (? 5, 6, 9).

The primary difficulty in determining the true characters of *Ph.*

* Hall and Clarke, Palaeont. New York, vol. vii, 1888, p. 140, pl. xx, fig. 17; pl. xxiv, figs. 7-12; Clarke, Mem. New York State Mus., No. 3, vol. iii, 1900, p. 24, pl. ii, figs. 24, 25.

africanus of Salter lies in the uncertain identification of the first specimen figured by Salter under this name. Lake, though largely successful in sorting the somewhat heterogeneous collection assembled by Salter under this name, felt doubtful about the type. But it may be regarded as fairly certain that the poor specimen in the British Museum, numbered 11295, from Leo Hoek, was the one from which Salter's partially restored figure was drawn, and it may have been that the specimen was subsequently somewhat damaged. It consists of a head-shield with part of the thorax attached, and the glabella shows the same characters of lateral furrows, etc., as in a similarly-preserved, nearly-complete individual (5420 S.A. Mus.) from Welvereden, Prince Albert, in the South African Museum, the depth of the basal furrows contrasting strongly with the weakness of the first and second furrows; the anterior end of the glabella is imperfect in both cases, but it seems to have been bluntly rounded. From Salter's poor specimen alone, assuming that No. 11295 in the British Museum is his figured type, we could hardly give a satisfactory definition of the species, but the Welvereden example, together with a beautiful thorax and pygidium preserved in a nodule as an internal cast and external impression in the Cape University Museum (321b, 321c) from the Hex River Valley (see below), allow us to clear up some uncertain points.

Clarke,* under the mistaken idea that Salter's *Ph. africanus* should be placed in *Cryphaeus*, expressed the view that Lake's specimens (67, 27, 222 S.A. Mus.) from Gamka Poort, figured as *Ph. africanus*, do not belong to Salter's species, though he stated that Salter's figure 1 (11295 Brit. Mus.) "makes an entirely normal accompaniment to the true *Cryphaeus* represented in his fig. 4." Ulrich† regarded his Bolivian species *Cryphaeus convexus* as much resembling *Ph. africanus*, but Knod‡ puts Ulrich's species in the genus *Acaste*.

Schwarz (*op. cit. supra*) established a species *Ph. acacia* for a certain form having a nuchal spine, a series of spines on the thoracic axis, and a subtriangular pygidium with a simple margin and no spines on the axis; but he was of the opinion that Salter's name, *Ph. africanus*, might have to be restored and the name *acacia* dropped. The new evidence which we now possess proves that Schwarz was right. Clarke, however (*op. cit.*), tried to establish Schwarz's species under his name on a firmer basis, but though the thorax and pygidium (*op. cit.*, figs. 7, 8) from the Falkland Isles which he figures are un-

* Clarke, *op. cit.*, 1913, pp. 112, 113, 129.

† Ulrich, Neues Jahrb. f. Miner. Geol., Beil. Bd. viii, 1893, p. 16, t. i, figs. 9-11.

‡ Knod, *ibid.*, Beil. Bd. xxv, 1908, p. 499, t. xxi, fig. 4.

doubtedly identical with Schwarz's *Ph. acacia* and with Lake's *Ph. cristagalli* (which Schwarz had pointed out was distinct from Woodward's *Encrinurus cristagalli*), the head-shields which Clarke figures (*op. cit.*, figs. 5, 6, 9) from the same region do not precisely agree with Salter's true *Ph. africanus* nor with Schwarz's *Ph. acacia*. We may here notice that Schwarz correctly recognised that one of the head-shields figured by Salter under the name *africanus* (*op. cit.*, pl. xxv, fig. 5, 11287 Brit. Mus.) was referable to the type of thorax with a median spine on each axial ring; and the meso-occipital ring has a corresponding nuchal spine, which is seen in all well-preserved examples of *D. africanus*.

Of Salter's other figures we may here state that the specimen of a thorax and pygidium (11284) from Gydo Pass represented in his second figure (*op. cit.*, pl. xxv, fig. 2) undoubtedly belongs to a species of *Calmonia* (*q.v.*), and not to a species of *Anchiopella*, as Clarke himself remarks. So that we should have to transfer the specific name *africanus* to this second specimen if we regard Salter's first figure as valueless owing to the doubtful identification of the specimen. Further remarks on this point are made below. Lake, however, though not referring to Salter's fig. 2, pursues the right course and figures specimens which undoubtedly belong to the only rational interpretation of Salter's species, and the first specimen which Lake figures (fig. 6) (67 S.A. Mus.) is the one to which his detailed diagnosis of the species applies. The weakness of the first and second pairs of glabellar furrows, and the strength of the third pair are noticeable features, the second furrows not reaching the axial furrows; the frontal lobe is obtusely angulated; the nuchal spine is not preserved in this specimen (though Lake correctly states there is one present in the species), because the middle part of the occipital ring is broken; Lake says that the genal angles are produced into short points, but they are also imperfect, and we can only say that they may have been bluntly pointed. There is no clear trace of any median spines on the thoracic axis in this specimen, though Lake believes that they were present. The margin of the pygidium (which is subparabolic rather than triangular in outline as described) is entire; the swollen elevated axis apparently projects somewhat behind, but there is no clear evidence of a terminal mucro.

In the other specimen (27 S.A. Mus.) figured by Lake (*op. cit.*, fig. 7) it is important to observe that this head-shield is on the same small piece of rock as his figured example of a thorax and pygidium of *Ph. cristagalli* (*op. cit.*, fig. 5), and occurs in close association, for our

fresh evidence proves that they belong to one and the same species. The head-shield is poorly preserved, except the eyes, which show about 20 rows of lenses, and are much elevated on swollen conical bosses opposite the second glabellar furrows. The cheeks seem to be bluntly pointed. The development of the glabellar furrows seems to be much the same as in the other figured specimen.

In the British Museum there is a complete partly-enrolled specimen (I 4047) from the Cedarberg, in which we can see the characters of the head-shield well preserved. The pentagonal glabella is obtusely angulated in front; the first and second lateral furrows are weak in comparison with the third lateral or basal furrows, which are strong, as in Lake's figured specimen (*op. cit.*, fig. 6 [67 S.A. Mus.]). The doublure and front part of the head-shield are excellently preserved in this British Museum specimen; the rostral doublure is obtusely triangular, bluntly pointed in the middle, convex and upturned; the edges meet in the middle at an angle rather greater than a right angle; and behind the rather wide rounded marginal portion of the doublure, or rostral shield, there is a median depressed triangular area. There is no rostral spine projecting in front. The genal angles are in this specimen broken off as usual, but the eye-lobes are well preserved and have the elongated shape and degree of upturning seen in one of Salter's figured specimens of *Ph. africanus* (11287 Brit. Mus., *op. cit.*, pl. xxv, fig. 5), in which, however, the glabellar furrows are more strongly and equally developed. The eyes are large, prominent, and have a high vertical lens-bearing surface. The lenses on the left eye are nearly perfect and are arranged in 22-24 vertical rows, having 7-8 lenses in the middle rows; the lenses are not in contact, but have small granules between them. The rostral doublure in our specimen (I 4047) is rather more finely granulated than the rest of the head-shield. The nuchal spine, as also in Salter's specimen, is well seen, and the thorax has the characters of *Ph. acacia*, showing the traces of the median spines on the axial rings quite distinctly, and the broad flattened anterior bands for enrolment on each axial ring are excellently displayed. The pygidium has the characters of Lake's *Ph. africanus*, the axis being very convex with a projecting tip. The whole surface of the head-shield is granulated; on the glabella the granulation is rather coarse, and on the free cheeks there are a few small oval pits arranged radially with some regularity on the outer slope below the eye, each pit being surrounded with a ring of granules. The thorax is also covered with closely-set granules, but not all of the same size.

Schwarz described the head-shield of his *Ph. acacia*, basing it on a very poor specimen (locality unknown) associated with the thorax and pygidium (2124 Alb. Mus.), and he described and figured it as having genal spines of a peculiar kind which Clarke does not show in his figures of head-shields attributed to the same species from the Falkland Isles. The head-shield, however, which Schwarz describes is only an impression, and is really better than his scanty figure indicates, though the genal spines, which are the important distinction, are not clearly distinguishable. The frontal lobe of the glabella is, however, visible, and is angulated in front; the first and second lateral furrows are weak, as usual, while the basal ones are deep; the eyes are prominent, and the whole surface of the head-shield is finely granulated. But, as is remarked below, Schwarz's figure closely agrees with the form here separated from *D. africanus* under the name *D. Baini*. There are many examples of detached head-shields undoubtedly referable to Salter's species in museums in South Africa (116, 17 Port Elizabeth), (1424, 1425 Alb. Mus., Bain Coll.), (H 75 Stell. Mus.), but in all cases the genal angles are imperfectly preserved. There is the internal cast of a nearly complete specimen in the South African Museum (5420 S.A. Mus.) from Welvereden, Prince Albert, having the head, thorax and pygidium nearly perfect, but only a few of the axial rings show the broken base of the spines. This specimen possesses in every respect the characters of that supposed to be Salter's fig. 1 of *D. africanus* in the British Museum (11295 Brit. Mus.), and the eye is well preserved and shows the large separated lenses alternating in adjacent rows as in the other better-preserved example in the British Museum (I 4047 Brit. Mus.) above described. The thorax and pygidium of the Welvereden specimen completely agree with the beautifully-preserved natural cast and impression of a thorax and attached pygidium (321*a*, *b*) in the Cape University Museum from the Hex River Valley, of which the cast in the British Museum made from this impression shows the upstanding axial spines on the thorax in a perfect condition, and it is precisely identical with Lake's *Ph. cristagalli* from Gamka Poort, and with Clarke's *Ph. acacia* from the Falkland Isles. The pygidium is not produced into a terminal mucro or spine, but ends in a blunt point behind the prominent convex cylindrical axis. The outline of the pygidium is characteristic, for the sides are somewhat excavated, the posterior part tapering less rapidly than the anterior, and the pleural lobes more strongly bent down near the tip. Clarke states that *D. acacia* had a "more extended caudal spine" than his *D. falklandicus*, which has a very

similarly-shaped pygidium, but his figures do not show it, and *D. africanus* has no definite mucro.

The name *Anchiopella* was suggested by the author * in 1907 for the subgenus of *Dalmanites*, comprising *D. cristagalli*, *D. acacia* [= *africanus* Salter sens. restr.], and *D. arbuteus*. Clarke † adopts it as a group name, and so does Kozłowski ‡ who credits Clarke with the name and uses it in a subgeneric sense, as is done here.

Dalmanites (Anchiopella) cristagalli (Woodward).

1873. *Encrinurus cristagalli* Woodward, Quart. Journ. Geol. Soc., vol. xxix, p. 31, pl. ii, figs. 6, 7.

? 1904. *Phacops arbuteus* Lake (pars), Ann. S. Afr. Mus., vol. iv, pt. 4, p. 203, pl. xxiv, fig. 4 (40 S.A. Mus.), non cet.

1906. *Phacops cristagalli* Schwarz, Rec. Albany Mus., vol. i, pt. 6, p. 392, pl. x, fig. 6.

Schwarz pointed out the differences between this species and *D. acacia*, and further remarks on it have been made above. Lake's figured specimen of *Ph. cristagalli*, as above stated, is identical with *Ph. acacia*, and distinct from Woodward's type, which came from the Cockscorn Mountains. One of the unnamed specimens of *Phacops* in the British Museum (48774) from Rozendal shows part of a pygidium with the coarse tubercles of *D. cristagalli*; otherwise I have not detected any other example of the species. Lake remarked on the close relationship of *D. arbuteus* and *D. cristagalli*, particularly in the tuberculation of the head (though Woodward's species was founded on a pygidium), but his association of the differently ornamented pygidium with the head-shield of *D. arbuteus* led him to separate them. In the new description given below by me of his first figured specimen of *D. arbuteus* (64 S.A. Mus.), which is a head-shield, the fact that both species at any rate belong to the subgenus *Anchiopella* is emphasised, and their separation must be left an open question. It is probable that the pygidium (40 S.A. Mus.), with the terminal spine referred by Lake to *D. arbuteus*, should be placed in *D. cristagalli*. Lake remarked on its similarity, and it lacks the coarse tuberculation, which is a marked feature of the head of *D. arbuteus*.

D. cristagalli differs from *D. africanus* in the presence of a few coarse rounded tubercles on the pleurae of the pygidium, and, as

* Reed, Geol. Mag. N.S., Dec. v, vol. iv, 1907, p. 168.

† Clarke, op. cit., 1913, pp. 147, 148, 154.

‡ Kozłowski, op. cit., 1923, pp. 33, 35, 51.

remarked below, the head-shield on which Lake founded his *D. arbuteus* may belong to it.

Dalmanites (Anchiopella) arbuteus, Lake (pars).

1904. *Phacops arbuteus*, Lake (pars), Ann. S. Afr. Mus., vol. iv, pt. 4, p. 203, pl. xxiv, fig. 2 (64 S.A. Mus.), *non* figs. 3, 4.

The head (64 S.A. Mus.) which Lake figured as the type of this species is much crushed and distorted, so that its real shape and characters are difficult to determine. But Lake's description is hardly adequate, and he seems to have attempted to include the characters of the other glabella (61 S.A. Mus.) which he figured (*op. cit.*, fig. 3) as belonging to it. The glabella appears to have been subpentagonal, and as wide as long, and has three pairs of well-defined lateral furrows extending inwards more than one-third across it; the anterior furrows seem to arise rather far back, *i.e.* at about half the length of the glabella, and are directed obliquely backwards, so that the frontal lobe must have been large; the second and third furrows are horizontal and subparallel. The basal lobes are very small. There is a certain definite arrangement of the tubercles on the surface, and they are unusually coarse and form short conical spines; there are two median longitudinal rows of them down the middle of the glabella, and the posterior five or six are arranged in pairs, but the anterior ones are less regular; there are similar large tubercles on each side, and each lateral lobe bears one or two. The meso-occipital ring has a short stout median nuchal spine. The cheeks are too imperfect for description, but the head-shield seems to have measured about 28–30 mm. in length, and the glabella about 23–24 mm. in width.

As Lake remarks, the coarse tuberculation suggests *D. cristagalli*, but we have no means of connecting the two species as they are based respectively on an isolated head-shield and an isolated pygidium from different localities. For the pygidium attributed by Lake to *D. arbuteus* (*op. cit.*, fig. 4) (40 S.A. Mus.) is quite differently ornamented, and the glabella (61 S.A. Mus.) (*op. cit.*, fig. 3) is also distinguished by the absence of the coarse spinose tubercles of the type specimen.

The only other specimen which I have seen that can be referred to *D. arbuteus* is a fragmentary head-shield (3884 S.A. Mus.) from Hottentot's Kraal, Ceres, showing the characteristic coarse tuberculation.

An imperfect head-shield from Bolivia, showing only a portion of a

glabella and the meso-occipital ring with nuchal spine, has been compared by Lake* with his *D. arbutus*, and it obviously belongs to *Anchiopella*, though the species is doubtful.*

We may perhaps compare the Bolivian *Anchiopella Haugi* Kozl.† with *D. arbutus* (sens. restr.), especially on account of the tuberculation and short broad glabella, and the glabellar furrows seem to be somewhat similarly developed.

Dalmanites (Anchiopella) Baini sp. nov.

(Pl. IX, figs. 1-3.)

? 1856. *Phacops africanus* Salter (pars), Trans. Geol. Soc., ser. 2, vol. vii, p. 218, pl. xxv, fig. 3 (*non cet.*) (11285 Brit. Mus.).

Head-shield transversely semicircular, distinctly angulated in front at 130° - 140° in a broad subogival point. Glabella broadly pentagonal, more than one-third the width of the head-shield, expanding gradually in width anteriorly, not swollen; sides straight, anterior end obtusely angulated; first lateral furrows placed far forward, arising a very little behind the lateral angles of the frontal lobe, long, straight, obliquely directed backwards, extending inwards about two-fifths the width of the glabella on each side; second lateral furrows gently arched or straight, less oblique, extending inwards as far as first furrows, but faintly or scarcely connected with axial furrows; third lateral furrows horizontal, nearly straight, slightly curved forwards at outer ends, deeper and stronger than second furrows, but as long and connected completely with axial furrows at sides; meso-occipital furrow deep, gently arched forwards. Frontal lobe of glabella short, broad, transverse, about twice as wide as long; second and third lateral lobes only faintly separated near axial furrow owing to weakness or obsolescence of outer ends of second lateral furrows. Meso-occipital ring rounded, bearing short stout median upstanding cylindrical spine. Anterior border of head-shield in front of glabella very narrow, rounded, separated off by strong continuous furrow. Facial sutures with anterior branches straight and parallel, and with posterior branches bending out at right angles behind eyes and running nearly straight and horizontally direct to marginal furrow, curving back sharply on crossing broad lateral border. Cheeks slightly swollen. Pleuro-occipital furrow strong, horizontal, nearly straight, meeting

* Lake, Quart. Journ. Geol. Soc., vol. lxii, 1906, p. 428, pl. xl, fig. 8.

† Kozłowski, *op. cit.*, 1923, p. 51, pl. ii, figs. 11-14.

marginal furrow at about 75° . Genal angles not produced, subrectangular, armed with short sharp subcylindrical spine directed straight backwards and situated rather inside outer angle, which is subtruncate. Eyes elevated, rather large, slightly oblique, extending back from level of first to third lateral furrows, with anterior end nearly touching glabella. Free-cheeks with broad shallow marginal furrow separating off rather wide gently convex border. Surface of head-shield covered with numerous closely-placed, small, low, rounded, irregularly-disposed pustules.

Thorax with broad strongly-convex axis bearing short vertical spine; pleurae gently arched down, strongly furrowed. Whole surface of thorax coarsely pustulated like head-shield. Pygidium triangular? mucronate, and with broad cylindrical prominent convex axis, annulated for nearly whole length with 9-10 rings, having blunt tip not reaching posterior margin; pleural lobes narrow, rather strongly arched down, rapidly decreasing in width posteriorly, composed of 5-6 low, rounded pleurae, with scarcely any trace of pleural furrows.

Dimensions :—

	(Sedgw. Mus.)	(26 S.A. Mus.)
Length of head-shield . . .	17.5 mm.	18.0 mm.
Width of " . . .	35.0 "	38.0 "
Length of glabella . . .	14.0 "	15.0 "
Width of " at front . . .	16.5 "	18.0 "
" " " at base . . .	11.5 "	14.0 "

Remarks.—There are two slabs of a rather micaceous greenish flaggy slate in the Sedgwick Museum from an unknown locality, presented in 1906 by the South African Museum, containing portions of 7 head-shields and 2 pygidia of the species. In the South African Museum there is another similar slab and its reverse (7200 S.A. Mus.) containing several head-shields, a pygidium and portions of the thorax, and in the Durban Museum there is a slab of identical lithological character with a head-shield showing the genal angle and a pygidium. It is on these specimens that the above definition is based. But there is also a head-shield (3934 S.A. Mus.) from Hottentot's Kraal in the South African Museum, and another (433 Pret. Mus.) from Boschluis Kloof in the Pretoria Museum, and another (139 Cape

Univ.) in the Cape University collection, which seem to have precisely the same characters.

The general characters of the glabella and head-shield recall *D. falklandicus* Clarke,* and the pygidium is almost identical in character; but the presence of the meso-occipital spine is distinctive, and the pleuro-occipital ring seems to be wider towards the genal angles. Clarke, moreover, does not mention or depict any axial spines on the thoracic segments.

The head-shield is much like that of *D. africanus*, but the glabella is more pentagonal, the two pairs of anterior furrows are stronger and deeper, the eyes are larger, and the ornamentation is much coarser. The genal spines are developed in rather an unusual way, and are well seen in the specimen (181 Cape Univ.) in the collection of the Cape University. Their shape and position are just as in Schwarz's fig. 4, pl. x (*op. cit.*), of the posterior edge of a head-shield attributed to *Ph. acacia*, which, he states, is a composite figure drawn from several casts of fragments. The thoracic segment (11285) in the British Museum, figured by Salter (*op. cit.*, pl. xxv, fig. 3) as belonging to *D. africanus*, may belong to *D. Baini*, and the pygidium from Gamka Poort (222 S.A. Mus.) figured by Lake (*op. cit.*, pl. xxiv, fig. 8), also as *D. africanus*, may be likewise referable to it. The thoracic segments of *D. Baini* seem to have shorter, smaller, axial spines than *D. africanus*, but only isolated and imperfect portions of the thorax are associated on the slabs with the head-shields and pygidia.

Dalmanites (Corycephalus ?) capensis sp. nov.

(Pl. VIII, figs. 5, 6.)

Head-shield semi-elliptical to semi-circular, gently convex, with the anterior border in front of the frontal lobe of the glabella furnished with a few short blunt denticulations. Glabella large, subpentagonal to subclavate, widening anteriorly, with straight sides and rounded anterior end; frontal lobe large, swollen, transverse, about half the length of the glabella, projecting slightly at sides, with median pit at base; second and basal lobes depressed, small, subequal, transverse; anterior lateral furrows strong, oblique, long; second and third lateral furrows represented by isolated transverse deep horizontal pits, scarcely connected with axial furrows, the third pair better marked. Axial furrows straight, diverging anteriorly. Occipital ring simple,

* Clarke, *op. cit.*, 1913, p. 105, pl. v, figs. 1-4.

well defined by deep furrow; meso-occipital furrow arched forward gently in middle; pleuro-occipital furrow wide, deep, meeting marginal furrow at about 60° . Pleuro-occipital ring rounded, widening slightly to genal angles. Lateral border raised, rounded, defined by definite furrow, wider and shallower than pleuro-occipital. Genal angles sharply rounded, not produced back. Facial sutures with posterior branch curving forward strongly in its outward course and then arching back to cut lateral edge some distance in front of genal angles. Eyes large, sharply bent, reaching from first to third lateral furrows, nearly touching axial furrows at front end, composed of 24-26 vertical rows of lenses. Eye lobe depressed, with swollen edge. Surface of glabella and border coarsely granulated. Cheeks covered with large, low, closely-placed, rounded tubercles, especially towards genal angles. Doublure in front ornamented with triangular group of similar tubercles; rest coarsely granulated.

Dimensions :—

	(216 Cape. Univ.)	(H 76 Stell. Mus.)
Length of head-shield . . .	18.0 mm.	29.0 mm.
Width of " . . .	40.0 "	c. 62.0 "
" glabella at base . . .	11.0 "	18.5 "
" " across frontal lobe . . .	17.5 "	28.0 "
Length of glabella . . .	16.0 "	26.0 "

Remarks.—There is one fairly-well preserved head-shield (H 76 Stell. Mus.) in the Stellenbosch Museum from Klein Straat Station, with three thoracic segments attached, but the whole specimen is rather crushed. The axis of the thorax is broad, and there are lateral swellings on each ring; the pleurae have a rather strong but rounded fulcrum at about half their length, and a deep, gently-sigmoidal, diagonal furrow. The marginal projections on the front of the head-shield are indistinctly seen.

The other specimen is a better head-shield (216 Cape Univ.) in the collection of the Cape University from Touws River Road. It shows clearly the marginal denticulations of the border in front of the frontal lobe, and is not much crushed; the peculiar ornamentation of the cheeks and median part of the doublure is well preserved, the rest of the surface of the head-shield being only coarsely and uniformly granulated.

This species is allied to *D. Drevermanni* Thomas* (non *Cryphaeus*

* Thomas, Zeitschr. deut. geol. Gesell., vol. lvii, 1905, p. 247, t. xi, figs. 1-3.

Drevermanni Richter, 1909) of the Devonian of the Argentine, and to *D. Boehmi* Knod * of Bolivia, especially its variety *boliviensis* described by Kozłowski.† It marks an early stage of the development of the denticulated or crenulated border of *Corycephalus*, and the same stage is seen in the North American Lower Devonian species, *D. stemmatus* Clarke,‡ *D. Dolbeli* Clarke,§ and others, as Clarke || has pointed out. If a distinctive subgeneric name is required for this group of species we may suggest *Ecocorycephalus*.

The head-shields of *D. capensis* and *D. caffer* are difficult to distinguish when the anterior margin and ornamentation are not preserved, as the glabella and general characters seem to be identical.

Dalmanites (*Hausmannia*) *Dunni* sp. nov.

(Pl. XI, fig. 5.)

1904. *Dalmanites* sp. Lake, Ann. S. Afr. Mus., vol. iv, pt. 4, p. 212, pl. xxv, fig. 7 (38 S.A. Mus.).

The fragmentary pygidium from Gamka Poort (38 S.A. Mus.), which Lake briefly described and figured without a specific name, deserves further mention. The whole pygidium is flattened and apparently broadly semilanceolate in outline, and probably pointed behind; the pleural lobes are flat and horizontally extended, and the portion of the left one which is preserved shows 10–11 simple pleurae which are flat and do not possess any pleural furrow; the interpleural grooves are sharp and deep. The pleurae diverge backwards and outwards from the axis and curve gently back, becoming more and more directed backwards; the last one is parallel to the axis. There are 10–11 pleurae preserved, of which the last 7 correspond to the axial rings, and probably this is the case also with the anterior ones, but the front part of the axis is missing. The axis is very elongated and conical, tapering very slowly, and shows 16–18 incomplete rings, the interannular grooves being very faint or obsolete across the middle. The whole surface is ornamented with rather coarse regular granulation. The actual margin of the pygidium is not preserved, but the

* Knod, Neues Jahrb. f. Miner. Geol., Beil. Bd. xxv, 1908, p. 508. t. xxi, fig. 1.

† Kozłowski, *op. cit.*, 1923, p. 36, pl. ii, fig. 1.

‡ Clarke, Mem. 3, New York State Mus., 1900, p. 15, pl. i, figs. 6–16; pl. ii, figs. 1, 2.

§ Clarke, Mem. 9, New York State Mus., pt. 1, 1908, p. 121, pl. viii, figs. 1–7.

|| Clarke, *ibid.*, p. 134.

length of the portion of the axis preserved is 37 mm., and of the pleural lobe 46 mm., and it may be estimated that when complete the pygidium measured at least 55 mm. Whether it had a terminal mucro or not is uncertain, but it was probably pointed behind. We may compare it with *D. Andii* Kozłowski* from the Devonian of Bolivia, but more especially with *D. Clarkei* Ulrich† from the same country, also founded on a pygidium.

Groth‡ has compared Clarke's *D. maccurua* from Brazil§ and Bolivia|| with this unnamed species of the Bokkeveld Beds figured by Lake, but Kozłowski (*op. cit.*) doubts if Knod's Bolivian specimen with its incomplete axial rings is referable to Clarke's *D. maccurua*, and Steinmann's¶ examples from the Cordillera Real are attributed by Kozłowski to a new species, *D. Andii*, while Groth's Brazilian specimen above mentioned is considered to resemble *D. Clarkei* Ulrich** rather than *D. maccurua*. Knod (*op. cit.*, p. 500) had observed that this South African form as figured by Lake was very similar to the *D. Clarkei* Ulrich from Bolivia. In view of the special peculiarities of our specimen we may give it a distinctive specific name, *Dunni*.

In another larger incomplete specimen, also from Gamka Poort (3949 S.A. Mus.), which probably belongs to the same species, the first six rings at the front end of the axis (which consists of 22-24 segments) are complete, and the posterior ones (16-18 in number) are incomplete across the middle. The last two pleurae arise from the sides of the axis some distance (7 or 8 rings) from its tip; all of the pleurae end a little inside the margin, as in *D. Clarkei*, with which our species seems undoubtedly most closely allied.

The species undoubtedly belongs to the subgenus *Hausmannia* as used by Hall and Clarke, Etheridge and Mitchell,†† and the author,‡‡ but the obsolescence of the pleurae before reaching the margin of the pygidium is peculiar.

* Kozłowski, Ann. Paléont., vol. xii, 1923, p. 38, pl. ii, figs. 3, 4.

† Ulrich, Neues Jahrb. f. Miner., Beil. Bd. viii, 1893, p. 19, t. i, fig. 13.

‡ Groth, Bull. Soc. Geol. France, ser. 4, vol. xii, 1912, p. 608, pl. xix, fig. 4.

§ Clarke, "Trilob. Grez de Erere, Brazil," Archiv Mus. Nac. Rio de Janeiro, vol. ix, 1890, p. 23, pl. ii, figs. 1-3, 6, 7, 10, 15.

|| Knod, Neues Jahrb. Miner., Beil. Bd. xxv, 1908, p. 500, t. xxi, fig. 3; Lake, Quart. Journ. Geol. Soc., vol. lxii, 1906, p. 429, pl. xl, fig. 11 ?.

¶ Steinmann, Neues Jahrb. Miner., Beil. Bd. xxxiv, 1912, p. 205, t. ix, figs. 1-3.

** Ulrich, Neues Jahrb. Miner., Beil. Bd. viii, 1893, p. 19, t. i, fig. 13.

†† Mitchell, Proc. Linn. Soc. New South Wales, vol. xlv, pt. 2, 1919, pp. 440-446.

‡‡ Reed, Geol. Mag., Dec. v, vol. ii, 1905, pp. 172-178 and 224-228.

Dalmanites (Hausmannia) lunatus, Lake.

1904. *Dalmanites lunatus* Lake, Ann. S. Afr. Mus., vol. iv, pt. 4, p. 212, pl. xxv, fig. 6 (66 S.A. Mus.).

The one small specimen (66 S.A. Mus.) on which Lake founded this species shows a subclavate glabella widening anteriorly, but the front edge is not preserved. It may also be remarked that the meso-occipital ring is simple and without any spine, and that the pleural lobes of the thorax are flattened and horizontal; the pleurae are nearly straight, with a long, straight, diagonal furrow, and have no distinct fulcrum. The axis of the pygidium is elongated and conical, with 10 complete rings preserved, but most of the pygidium is missing. The species appears to be allied to *Dalmanites patacamayensis* Kozl.* rather than to *D. maecurua*, Clarke † as far as the head-shield, eyes, and thoracic pleurae are concerned, but the pygidium has an axis more like that of *D. Andii* Kozl.‡ The small, broken example which Lake figured measures about 32 mm. in length and the head has a width of about 24 mm. Probably it is a young individual.

Dalmanites (Hausmannia) ? sp.

One imperfect head-shield (202 Cape Univ.) from Touws River Road in the Cape University has much the characters of the one figured by Clarke§ as *Dalmanites* sp. ind. from Tybagy. The frontal lobe bears near its middle and anterior border an irregular assemblage of rather large, rounded, low tubercles, with a few larger ones amongst them, and there are similar ones on the middle portion of the glabella between the first and second lobes. The other parts of the glabella are merely coarsely granulated, but the tubercles are present again on the free cheeks. *D. accola* Clarke,|| from Ponta Grossa, has similar coarse ornamentation, but the glabella is longer and more clavate in shape instead of subpentagonal. Indeed our specimen has a glabella and lobation apparently identical with *D. (Cryphaeus) caffer*, as here defined, but the genal angle on the left side, which alone is partly preserved, suggests that it was produced back into a flattened spine rather than merely bluntly pointed, and the frontal lobe of the glabella

* Kozlowski, Ann. Paléont., vol. xii, 1923, p. 36, pl. ii, fig. 2.

† Clarke, *op. cit.*, 1890, p. 23, t. ii, figs. 10-15; Knod, Neues Jahrb. f. Miner. Geol., Beil. Bd. xxv, 1908, p. 500, t. xxi, fig. 3.

‡ Kozlowski, *op. cit.*, p. 38, pl. ii, figs. 3, 4.

§ Clarke, *op. cit.*, 1913, p. 107, pl. iv, figs. 19-21.

|| *Ibid.*, p. 101, pl. iv, figs. 9-18.

is less inflated and there is no evidence of a frontal rostrum. But our specimen is somewhat crushed and the anterior margin is rather broken. The ornamentation and general characters of the head recall *D. phacoptyx* Hall and Clarke * from the Grande Grève Limestone.

Dalmanites (Proboloides) ensifer sp. nov.

(Pl. VIII, figs. 4, 4a-d.)

Head-shield transversely semicircular with a stout, median, flattened, rostral spine projecting in front and slightly upturned; genal angles provided with short, triangular, sharp spines, slightly supragenal, and projecting backwards and a little outwards, not in a line with the lateral margins of the head-shield; posterior margin slightly sigmoidal. Glabella subpentagonal, widening anteriorly, obtusely angulated, but rounded in front; first lateral furrows strong, oblique, long, straight, inclined at very obtuse angle to sides; second lateral furrows horizontal, very weak at outer ends, but deepening inwards into short, transverse pits; third lateral furrows stronger, nearly horizontal, but weak at outer ends. Frontal lobe large, transverse, rather swollen, slightly overhanging at lateral angles, about half length of glabella, with pair of faint, convergent depressions, running inwards a short distance from anterior margin with a V-shape group of large tubercles between them and an outer line of 3-5 similar tubercles on the outer slopes of the frontal lobe, converging inwards towards a median circular pit near its base. Second and third lateral lobes with tendency to fusion at outer ends. Axial furrows strong, straight. Cheeks arched down on each side, triangular, not swollen, sparsely pitted. Facial sutures rather sharply bent in at lateral angles of frontal lobe. Eyes rather small, situated far forward, extending from level of first lateral furrows to slightly behind second lateral furrows of glabella, constricted at base, composed of 26-27 vertical rows of lenses with 8-9 lenses in central rows; eye lobe slightly convex, with groove inside swollen edge. Meso-occipital furrow strong, arched forward in centre, deepest at sides; meso-occipital ring simple, rounded, without spine or tubercle. Pleuro-occipital furrow strong, straight, meeting marginal furrow at about 60°; pleuro-occipital segment widening laterally, smooth. Lateral border of head-shield gently convex above, with sharp outer edge, well defined from cheeks by shallow marginal furrow; border narrowing much in front of

* Clarke, Mem. 9, New York State Mus., pt. 1, 1908, p. 123, text-fig. and pl. vii, figs. 5-10.

glabella. Doublure of head-shield with narrow lateral channelled bands widening anteriorly into flattened, triangular, median plate with weak, rounded, lateral borders and depressed central portion, produced into long upturned rostral spine.

Dimensions (C 2 Stell. Mus.) :—

Length of head-shield to base of rostral spine	26.0 mm.
Width of ,, at base	50.0 ,,
Length of glabella	22.0 ,,
Width ,, ,, at base	17.5 ,,
,, ,, ,, across frontal lobe	23.0 ,,
Length of frontal lobe	12.0 ,,
,, ,, eye	6.5 ,,
,, ,, genal spine	5.0 ,,
Estimated length of rostral spine	15.0 ,,

Remarks.—The head-shield (C 2 Stell. Mus.) in the Stellenbosch Museum on which this species is founded is complete, except for the anterior part of the rostral spine. The locality at which it was found is unfortunately unknown. The presence of the long rostral spine recalls the *Probolium* * condition and resembles the Brazilian trilobite *Proboloides cuspidatus* Clarke,† but in other characters the head-shield is more like *D. paituna* Hartt and Rathbun,‡ while the channelled doublure and rostral shield resemble *D. falklandicus* Clarke.§ *D. brevicaudatus* Kozl.|| from Bolivia possesses a somewhat similar rostral spine, but in other characters it is different.

Dalmanites (Acastella ?) pseudoconvexus sp. nov.

(Pl. IX, figs. 8, 9 ? .)

Head-shield transversely semicircular, slightly angulated in front, strongly convex from side to side. Genal angles provided with rather long, slender, rounded spines, projecting backwards. Glabella subquadrate, not widening anteriorly, parallel-sided, anterior end rounded; frontal lobe short, transverse, not swollen; first lateral furrows oblique; second lateral furrows short, horizontal, weaker at outer ends; basal lateral furrows strong, deep, ending with pit at inner ends; axial furrows shallow, faint, parallel. Meso-occipital

* Clarke, Mem. 9, New York State Mus., pt. 1, 1908, pp. 131–133.

† Clarke, "Foss. devon. Parana," 1913, p. 135, pl. vii, figs. 13–19.

‡ Clarke, Archiv Mus. Nac. Rio de Janeiro, vol. ix, 1890, p. 39, t. i, figs. 13, 16, 17; Lake, Quart. Journ. Geol. Soc., vol. lxii, 1906, p. 429, pl. xl, figs. 9, 10.

§ Clarke, *op. cit.*, 1913, p. 105, pl. v, figs. 1–4.

|| Kozłowski, *op. cit.*, 1923, p. 39, pl. ii, figs. 6–8.

furrow strongest at sides, arched forward in middle; meso-occipital ring rounded, simple, without nuchal spine or tubercle. Cheeks broadly triangular, gently convex, arched down. Eyes small, prominent, elevated, extending from behind first lateral furrow to middle of second lateral lobe of glabella, with high, vertical, strongly arched, lentiferous face bearing 22-23 vertical rows of lenses, with 8-10 lenses in middle rows. Pleuro-occipital furrow nearly straight, strong, meeting very weak, broad, shallow, marginal furrow at about 60°; lateral border of head-shield scarcely marked off, somewhat flattened. General surface of head-shield granulated. Frontal lobe of glabella with a few indistinct small tubercles.

Dimensions (419 Kimb. Mus.) :—

Length of head-shield	.	.	20 mm.
Width of „	.	.	36 „
Length of glabella	.	.	16 „
Width of „	.	.	16 „

Remarks.—This head-shield which comes from Hoenderfontein, Clanwilliam, is almost identical (except for the genal spines) with the Bolivian *Cryphaeus convexus* Ulrich,* a species which Knod and Groth† placed in the genus or subgenus *Acaste*. It is also much like *Dalmanites Heberti* Gosselet‡ which Barrois§ and others consider identical with *Acaste spinosa* Salter. But it seems to be extending too much the meaning of *Acaste* (if we retain the name at all) to include these forms in that genus or subgenus. *A. spinosa* occurs in the Siluro-Devonian beds of Lievin, but it is typically a Silurian species. The characters of the head-shield, glabella and eyes of *A. Lombardi* Kozłowski,|| from the Devonian of Brazil, seem to present a considerable resemblance to our new South African species, but Kozłowski does not state that the genal angles are spined. However, he states that it belongs to the austral group of species, having a head-shield much like *Dalmanites* with a pygidium possessing the characters of *Phacops*.

In the South African Museum there are some pygidia (7201 S.A. Mus.),

* Ulrich, Neues Jahrb. f. Miner. Geol., Beil. Bd. viii, 1893, p. 16, t. i, fig. 9; Knod, *ibid.*, Beil. Bd. xxv, 1908, p. 499, t. xxi, fig. 4.

† Groth, Bull. Soc. Geol. France, ser. 4, vol. xii, 1912, p. 607, pl. xviii, fig. 4, 4a; pl. xix, fig. 1.

‡ Gosselet, Esquisse Geol. Nord, 1880, p. 66, pl. i, fig. 4.

§ Barrois, Leriche, etc., "Faune Siluro-devon. Lievin," Mém. Soc. Geol. Nord, vol. vi, pt. 2, fasc. 2, 1920, p. 120, pl. xv, figs. 6, 7; p. 160, pl. xvii, figs. 1, 2.

|| Kozłowski, "Foss. dev. Parana," Ann. de Paléont., vol. viii, 1913, p. 14, pl. iii, figs. 7, 7a, b.

also from Hoenderfontein, in precisely the same condition and matrix as the above-described head-shield from this locality, and from their resemblance to that of the above-mentioned *D. Heberti* Gosselet we may refer them without much hesitation to the same species. The description is as follows: Pygidium triangular, as wide as long, sharply pointed behind, the sides converging at about 75° to meet in a short, sharp, flattened mucro. Axis wide, convex, conical, regularly tapering to blunt tip at base of mucro, with anterior half composed of 3-5 complete rings, but posterior half faintly annulated with 5-7 rings. Pleural lobes wide, gently inclined, the anterior edge with obtuse fulcrum situated at less than one-third the width, and having a strong, oblique furrow behind it; pleurae 3-4 on each side, low, straight, broad, ending inside border, and having faint, straight, median furrow; interpleural furrows weak. Border smooth, somewhat flattened, not definitely marked off. General surface of pygidium closely and coarsely granulated.

Dimensions :—

Length of pygidium with mucro	20 mm.
Width of " . . .	23 ,,
Width of axis . . .	9 ,,

In a recent paper * on a Silurian type of pygidium from the Upper Ludlow of the Woolhope district, the author has suggested the sub-generic name *Acastella* for the group of species comprising "*Acaste*" *spinosa* and *D. Heberti*, and it seems probable that our new Bokkeveld species from Hoenderfontein belongs to it.

Dalmanites (Cryphaeus) caffer Salter (emend.).

(Pl. IX, figs. 10, 11; Pl. XI, fig. 4.)

1856. *Phacops (Cryphaeus) caffer* Salter (pars), Trans. Geol. Soc., ser. 2, vol. vii, p. 219, pl. xxv, figs. 11, 12, 12a (11290 Brit. Mus.), *non* figs. 10, 13.
1856. *Phacops africanus* Salter (pars), *ibid.*, pl. xxv, fig. 4 (11286 Brit. Mus.), *non. cet.*
1904. *Phacops (Cryphaeus) caffer* Lake, Ann. S. Afr. Mus., vol. iv, pt. 4, p. 210, pl. xxv, figs. 3, 4 (18, 34 S.A. Mus.).
- ? 1923. *Cryphaeus australis* Kozłowski (pars), "Faune Devon. Bolivie," Ann. de Paléont., vol. xii, p. 41, pl. iii, figs. 15-17 (*non cet.*).

* Reed, Geol. Mag., vol. lxii, No. 728, 1925, p. 73, pl. ii, figs. 4, 4a.

The first figured specimen (Salter, *op. cit.*, fig. 10) of this species is a head-shield described as "a young individual," but unfortunately its characters do not at all agree with Salter's definition of the species, which, on the other hand, describes the characters found in the second figured specimen (*op. cit.*, fig. 11). It is therefore the latter which must be regarded as the type of the species, and the "young individual" has to be placed either in Lake's *Phacops*^a (*Calmonia*) *ocellus* (*q.v.*), or in the author's new species, *Ph. (Calm.) Lakei*.

The specimen (11290) of the head-shield from Leo Hoek figured by Salter (*op. cit.*, fig. 11), which is chosen here as the type of *Ph. caffer*, has a small median frontal apiculus or rostral point and subangular genal angles. Though the base of the glabella and occipital ring are missing, we can see that the frontal lobe is transverse and inflated, and has its lateral angles slightly overhanging; the lateral furrows, so far as they are preserved, are correctly shown in Salter's figure, and the anterior branches of the facial sutures meet at an obtuse angle in front of the glabella. The general surface of the glabella is covered with small, scattered, rather distant tubercles or coarse granulations, but on the frontal lobe they are more numerous and rather larger, and seem to be more or less fused into sinuous lines. The border is gently rounded, but only finely granulated, and the cheeks are coarsely pitted, while in the shallow, wide, marginal furrow are short, weak, radial markings, such as Clarke* shows in the figure of an unnamed species of *Dalmanites* from Bolivia.

Dimensions (11290 Brit. Mus.): Length of head-shield, 30-35 mm.; Width of head-shield, c. 70 mm.

There is a good head-shield (838 S.A. Mus.) from an unknown locality in the South African Museum, and a large number of specimens of this type of head-shield in the collection of the University of Cape Town (142, 169, 175, 179), from the Touws River Road, in a good state of preservation, and the following emended description of the specific characters of the head-shield may be given: Head-shield semi-circular to semi-oval, moderately convex, cheeks not much bent down; genal angles bluntly pointed, not spinose, the lateral and posterior margins being inclined at an angle of about 75°. Glabella subquadrate to subclavate, the frontal lobe very large and inflated, equal to or more than half the length of the glabella, with median pit at base; posterior half of glabella depressed, somewhat flattened; first lateral furrows strong, straight, oblique; second and third lateral furrows

* Clarke, *op cit.*, 1913, pl. v. figs. 16, 17.

horizontal, represented by long transversely oval pits, usually connected by weak grooves with axial furrows; second and third lateral lobes subequal, small, partly confluent at outer ends. Meso-occipital ring simple, rounded; meso-occipital furrow strong, gently arched forward. Cheeks rather swollen, with well-defined lateral border, marked off by distinct broad marginal groove; pleuro-occipital ring rounded; pleuro-occipital groove strong, deep, straight, uniting with marginal groove at angle of about 75° . Eyes rather large, elevated, reaching from first lateral furrow to middle of second lateral lobe, situated close to glabella; eye lobe convex, with submarginal groove and swollen edge. Pre-glabellar border of head-shield very narrow, but produced in front into very short, triangular, spatulate, flattened rostrum. Surface of head-shield covered with coarse granulations of rather unequal size. Doublure rounded, convex around anterior cephalic edges, but slightly bent up and concave in middle.

For the association of the head-shield which Lake described as *Ph. caffer* with the pygidium and thorax which he figured under the same name, he relied on associated but disconnected portions. But though isolated head-shields and pygidia are more abundant there is the impression of a complete individual (H 173) in the Stellenbosch Museum from Buffelskraal, and of another from the Cockscorn Mountains in the Bloemfontein Museum, which remove any doubt from our minds of the accuracy of Lake's view. Lake's pygidium of *Ph. caffer* agrees, however, in all essentials with the one from Hottentot's Kloof which Salter figured (11286 Brit. Mus.) (*op. cit.*, pl. xxv, fig. 4) as belonging to *Ph. africanus*, but it is in a crushed and somewhat distorted condition, so that the marginal spines are unduly elongated, and Salter's figure is largely a restoration. Clarke* considered that Salter's specimen was "a very exact expression of *Cryphaeus australis* Clarke," and Salter's figure would lead us to this conclusion if we had not had the opportunity of seeing the specimen itself. Lake's specimen of the pygidium of *Ph. caffer* is in a much better state of preservation, and from an examination of a large number of similar pygidia from the Bokkeveld Beds we are able to define its characters as distinct from those of *Cryphaeus australis*. The differences consist in the shorter, broader, and more incurved subfalcate shape of the marginal spines of the pygidium, and especially in the absence of a terminal median point, the margin between the last pair of spines being usually truncated and projecting merely as a short, broad,

* Clarke, *op. cit.*, 1913, pp. 113, 108a-114.

rounded lappet, just as in certain Bolivian specimens attributed to *Cryphaeus australis* by Kozłowski (*op. cit.*, pl. iii, figs. 15–17).

From two excellent pygidia with portions of the thorax attached (E 414, E 483, Stell. Mus.), from Osplaats, Hex River Valley, and the complete individual (H 173), also in the Stellenbosch Museum, from Buffelskraal, De Doorns, as well as from the fine specimen in the Bloemfontein Museum from the Cockscomb Mountains, and from specimens in the Sedgwick Museum, Cambridge, and others collected by me near De Doorns, we are able to give a fuller description of the characters of the thorax and pygidium than was previously possible:—

Thorax somewhat flattened. Axis convex, broad, fully one-third the width of thorax at front end, tapering rather rapidly; axial rings with slight lateral swellings. Pleurae horizontal out to fulcrum, which is situated at less than half their length, then bent down and slightly curved forwards; pleural furrow deep, strongest at fulcrum, dying out before reaching tip of pleurae, curving somewhat forwards beyond fulcrum; pleurae ending in free, short, slightly-falcate points. Pygidium broadly semi-elliptical to subparabolic, very gently convex from side to side, angulated at tip. Axis wide, conical, tapering rather rapidly for first 5 rings and then more slowly to blunt tip at some distance inside margin, annulated for whole length with 9–12 rings, of which the anterior ones have distinct lateral swellings. Pleural lobes composed of 5 pairs of pleurae, ending in short, broad, sub-falcate, free marginal spines, directed backwards and of subequal size, usually slightly swollen and more or less curved inwards, the last pair projecting behind the posterior margin of the pygidium and embracing a short, transversely, subquadrate, median postaxial piece (caudal lappet) arched up in the middle, and with sharply or broadly rounded tip; each pleura traversed by deep, rounded, broad, sub-median furrow, expanding outwards and ending suddenly before base of spine; interpleural furrows fine, narrow, not deeply impressed. Behind the fifth pleura there is a narrow, weak, curved, rounded ridge, running straight back on each side and passing into the lateral margins of the postaxial piece, representing a sixth pair of pleurae. Surface of axis coarsely granulated; pleural lobes with smaller granulations.

(In some specimens (11286 Brit. Mus.) there is a small, median, marginal swelling on the postaxial piece of the pygidium, but in most cases it is not visible.)

Dimensions :—

	(Bloemfontein.)	(H 173 Stell. Mus.)	(142 Univ. Cape.)
Length of head-shield .	23 mm.	15 mm.	26·5 mm.
Width of " .	38 "	30 "	45·0 "
Length of glabella .	21 "	c. 14 "	20·5 "
Width of " at base	14 "	9 "	14·0 "
" " " at front	20 "	15 "	23·0 "
Length of eye . .	9 "	c. 5 "	..
" of thorax . .	35 "	20 "	..
" of pygidium .	19 "	13 "	..
Width of " .	25 "	c. 19 "	..

Remarks.—As above mentioned, the pygidium of *D. caffer* is almost identical with certain Bolivian specimens attributed to *Cr. australis*, the truncate shape of the median unpaired lappet being characteristic in the Bokkeveld species. The thorax seems to possess no definite distinctive features. The head-shield, however, has a more inflated frontal lobe, larger eyes, and a frontal rostrum such as we find in *Dalmanites longicaudatus* Murch. of the British Upper Silurian, as Clarke mentions in connection with *Proboloides*, which is the austral equivalent of the boreal *Probolium*. The Canadian species from Gaspé, *D. Griffoni* Clarke,* and *D. Gaveyi* Clarke,† which occur there in the early Devonian fauna, are closely similar. But *Cr. australis* has no such marginal projection, and it is not always preserved in our Bokkeveld specimens. Kozłowski ‡ believes that *Cr. giganteus* Ulrich§ which was founded on a pygidium, is identical with *Cr. australis*.

Of European species we may especially mention *Cr. rotundifrons* Emmr. || from the Upper Coblenzian, for it has a small rostrum to the head-shield and rather broad incurved marginal spines on the pygidium, as well as a glabella with characters much like *Cr. caffer*.

The name *Cryphaeus* Green, is employed here in place of *Pleuraanthus*, Corda, in spite of its preoccupation as pointed out by the

* Clarke, Mem. 9, New York State Mus., pt. 1, 1908, p. 103, pl. vii, fig. 4; pl. ix, fig. 4, text-fig. p. 133.

† *Ibid.*, p. 128, pl. viii, figs. 8, 9, text-fig. p. 133.

‡ Kozłowski, *op. cit.*, 1923, p. 41.

§ Ulrich, *op. cit.*, 1893, p. 14, t. iii, fig. 6 (? 7, 8).

|| Richter, Jahrb. preuss. geol. Landesanst., Bd. xxxvii, 1916, Heft i, p. 250. t. xxvi, figs. 7–14.

author in 1905.* For Clarke † and all other palaeontologists still use Green's name, as they are of the opinion that no confusion can arise in its well-established application to this type of trilobite.

Dalmanites (Cryphaeus) caffer, Salter, var. nov. *albana*.

(Pl. XI, fig. 1.)

There is a nearly perfect, but slightly distorted, impression of a large head-shield of a species of *Phacops* from Winterhoek, in the Albany Museum (69), which deserves description. The head-shield is transversely semicircular, more than twice as wide as long; the anterior margin is very obtusely angulated in the middle. The glabella is broadly subquadrate, but widens slightly anteriorly; its sides are straight, and its front end is rounded; its whole surface is rather inflated. The frontal lobe is somewhat more swollen and is marked off behind by long, straight, oblique lateral furrows, which are strongly impressed except near their commencement; the second and third lateral furrows are straight, nearly horizontal, and deepest internally, being very faint and weak near their outer ends. The meso-occipital furrow is straight and deepest at the sides, and the meso-occipital ring is a simple rounded band without any nuchal spine. The cheeks are rather coarsely pitted, and the eyes are rather large and prominent, reaching from the first to somewhat behind the second lateral furrows; the eye lobe is angulated. The genal angles are broken off, but the pleuro-occipital furrow which is straight meets the marginal furrow at about 45°, so that they were probably bluntly pointed. The whole surface of the glabella is covered with small round tubercles, and there is a median pit at the base of the frontal lobe.

Dimensions (69 Alb. Mus.) :—

Length of head-shield . . .	24 mm.
Width of " " . . .	58 "
" " glabella at base . . .	20 "
" " " at front . . .	26 "

Remarks.—This head-shield differs from *D. caffer* as above defined by the more subquadrate shape of the glabella and absence of a frontal projection. In these respects it resembles the Bolivian trilobite figured and described by Kozłowski ‡ as *Cryphaeus australis*

* Reed, Geol. Mag., Dec. v, vol. ii, 1905, p. 173.

† Clarke, "Foss. devon. Parana," 1913, p. 108.

‡ Kozłowski, *op. cit.*, 1923, p. 41, pl. iii, figs. 1, 9–11.

Clarke, var. *rotundata*, which is certainly distinct from the typical *Cr. australis* which has a subclavate glabella, and this Bolivian variety seems to deserve specific rank. The tuberculation in our specimen from Winterhoek is coarser than in *Ph. caffer*, and is more like that of Kozlowski's other variety, *Cr. australis* var. *tuberculata*.*

Dalmanites (Cryphaeus) caffer, Salter, var.

There is one specimen (161 Cape Univ.) from the Touws River Road in the collection of the Cape University which consists of a pygidium, with 5 thoracic rings attached, showing some minor characters which seem to mark it off as a variety. The axis decreases more rapidly in width in the anterior half, but in the posterior half is nearly cylindrical. The median lappet projects more than in the typical *D. caffer*, forming a short, bluntly-pointed, sublanceolate process, instead of being abruptly truncate, and on the edge at its tip there seem to be 1 (or 2) small spinose, upturned tubercles. Salter showed a small, median swelling in the same place in his figure (*op. cit.*, pl. xxv, fig. 4) of the pygidium (11286 Brit. Mus.), which he attributed to *Ph. africanus*, but which we now refer to *Ph. caffer*. The five pairs of lateral lappets in our specimen have their surface angulated along their length instead of simply rounded, and this does not seem due to crushing. The whole surface of the pygidium is coarsely granulated, and in all other respects but the above-mentioned seems indistinguishable from the ordinary *D. caffer*. Some figures of pygidia of *Cr. australis* given by Clarke and Kozlowski appear identical with our variety (except in the terminal tubercles), and we may specially mention that of the variety *tuberculata* Kozl.†

Dalmanites (Cryphaeus) cf. australis Clarke.

(Pl. XI, fig. 9.)

It is possible that this species is represented in the Bokkeveld Beds, for there is one specimen of a head-shield (3850 S.A. Mus.) from Hottentot's Kloof, Ceres, which resembles some of those figured by Clarke ‡ more closely than it does those ascribed in this memoir by the present author to *D. (Cr.) caffer*. The eyes are smaller and placed further forward than in the latter, the genal angles are more acutely

* Kozlowski, *op. cit.*, 1923, p. 43, pl. iii, figs. 20, 21.

† *Ibid.*, p. 43, pl. iii, fig. 21.

‡ Clarke, *op. cit.*, 1913, pl. iii, figs. 10, 13, 14; pl. iv, fig. 3.

pointed and somewhat prolonged backwards, and the frontal lobe of the glabella is less inflated. All Kozłowski's figures of head-shields which he ascribes to *Cr. australis* have too broad and subquadrate a glabella to be regarded as identical with this species.

Dalmanites (Cryphaeus) cf. Pentlandi, Salter.

(Pl. XI, fig. 10.)

There is one imperfect pygidium (447 Pret. Mus.) in the Pretoria Museum from Tunnel Siding near Triangle, which is referable to some species of *Cryphaeus*, and deserves some description on account of its unusual ornamentation. The right pleural lobe is hidden beneath tough matrix, and the marginal spines, with the exception of the fifth one on the left pleural lobe, are broken off. The pygidium has the shape and general characters of *Cr. caffer*. The axis is conical and is annulated to the blunt tip with 11 rings. Behind it is a small, smooth, postaxial piece, apparently truncated and not pointed behind, and embraced laterally by the nearly obsolete, short, faintly-marked, curved, sixth pleurae, which have no free ends. The pleural lobes are flattened and composed of 5 elevated pleurae, each divided in its outer two-thirds by a median or submedian furrow into an anterior and posterior band of equal or subequal width. The pleurae die out before reaching the edge, leaving an ill-defined border; the marginal spines are broad, curved, unfurrowed, and flattened. Along the inner part of the anterior and posterior band of each pleura is a single row of 5-7 coarse, rounded tubercles, and on each ring of the axis there are 6-8 similar equidistant tubercles, arranged in roughly-longitudinal lines for the whole length of the axis.

The only species described which has a somewhat similar tuberculation and rudimentary sixth pair of pleurae on the pygidium is the imperfectly known *Cr. Pentlandi* Salter,* from Bolivia.

In the South African Museum there is the impression of the thorax and pygidium of a large example of this form from De Doorns (2463 S.A. Mus.), showing the coarse tuberculation very clearly. The axis of the thorax is broad and subcylindrical, decreasing very slowly in width posteriorly, and the rings are very coarsely tuberculated and have a few transverse wrinkles, but the tubercles are irregularly distributed, whereas on the attached pygidium they are in a regular single row, as in the other specimen (447).

* Salter, Quart. Journ. Geol. Soc., vol. xvii, 1861, p. 65, pl. iv, fig. 9; Kozłowski, *op. cit.*, 1923, p. 46, pl. ii, fig. 18.

The thoracic pleurae are likewise coarsely and rather irregularly tuberculated, but the tubercles tend to be arranged more definitely in a row or rows along the anterior and posterior pleural bands, and there is a curious transverse wrinkling of the pleurae as of the axis, recalling that seen in some species of *Dionide*; the pleural furrow is strong, deep, slightly diagonal, and submedian; the fulcrum is obtuse and situated at one-third to one-fourth the length of the pleurae. In the pygidium the sixth rudimentary pair of pleurae are well seen, curving in, and forming the sides of the postaxial piece behind the end of the axis. The postaxial piece is bluntly pointed and slightly swollen at the tip.

Dimensions (2463 S.A. Mus.):—

Length of thorax	.	.	46 mm.
Width of thoracic axis	.	.	18 „
Length of pygidium	.	.	25 „

Dalmanites (*Cryphaeus* ?) cf. *rostratus*, Kozłowski.

(Pl. VIII, fig. 2.)

1923. *Cryphaeus rostratus* Kozłowski, "Faune Devon. Bolivie,"
Ann. de Paléont., vol. xii, p. 44, pl. v, figs. 1-10.

The peculiar upturned rostral doublure which Kozłowski describes and figures in his new species *Cr. rostratus* from the Devonian of Bolivia, is excellently exhibited in a specimen collected by myself at the roadside cutting north of De Doorns. The anterior view of the head is alone displayed, the upper surface being buried in matrix, but part of the frontal lobe of the glabella with the encircling facial sutures, the lateral margin of the right cheek, as well as the triangular, gently-concave rostrum which bends up suddenly almost at right angles to the general plane of the head-shield, are clearly seen, and the granular ornamentation over the whole surface also precisely corresponds with the Bolivian examples. The height of the rostrum is about 8.5 mm., and its subacute tip stands up prominently above the level of the frontal lobe of the glabella, as in Kozłowski's figures 7 and 5a.

As he remarks, this species differs considerably from all other species comprised in the subgenus *Cryphaeus*, not only in the upturned rostral process, but also in the prominence of the eye lobes which stand up as spines, and in the shape and lobation of the glabella, and I believe it is more allied to his *Proboloides Cottreaui*,* which has a

* Kozłowski, *op. cit.*, 1923, p. 53, pl. ii, figs. 10, 10a.

somewhat similar upturned rostral doublure. The thorax and pygidium of this species also possess certain peculiar features, but no fragments of these parts have been detected by me in the South African collections.

Dalmanites (Cryphaeus ?) ceres, Schwarz.

? 1903. *Phacops arbuteus*, Lake (pars), Ann. S. Afr. Mus., vol. iv, pt. 4, p. 203, pl. xxiv, fig. 3 (61 S.A. Mus.) (*non* figs. 2, 4).

1906. *Phacops (Cryphaeus) ceres*, Schwarz, Rec. Albany Mus., vol. i, pt. 6, p. 394, pl. x, figs. 1, 1a (67 Alb. Mus.).

This species was founded on two head-shields in the Albany Museum (locality unknown), and its author considered that it was very close to *Ph. (Cryph.) giganteus* Ulrich, from Bolivia, which Kozłowski * believes is identical with *Ph. (Cryph.) australis* Clarke (*q.v.*). With Schwarz's view I can only agree, if we admit that Kozłowski is right in referring all the Bolivian specimens which he figured to Clarke's species.

The figure which Schwarz gave is poor and somewhat misleading, for the glabella is pentagonal and widens a little anteriorly, though it is drawn as parallel-sided; there is also a pair of parallel longitudinal rows of tubercles on the frontal lobe, as in *Ph. callitris* Schw., with some irregularly disposed tubercles on each side. There is no nuchal spine, the meso-occipital ring being smooth and simple. The genal angles are broken; the pleuro-occipital furrow is straight. In the paratype (27 Alb. Mus.) the blunt rostral angulation in the middle of the anterior margin of the head-shield is preserved, but it is broken off in the figured specimen. The eyes possess 24–25 vertical rows of lenses, with 7–8 lenses in the middle rows.

It seems to the present author that the figured head-shield is closely similar to the imperfect one from Gamka Poort, which Lake ascribed to *Ph. arbuteus* (*op. cit., supra*) (61 S.A. Mus.), for this has a much less coarse tuberculation of the surface than the type of Lake's species (Lake, *op. cit.*, pl. xxiv, fig. 2); the distribution of the tubercles is quite different, and there are other points of distinction; the glabella is subpentagonal in shape, though owing to distortion its true outline is difficult to determine, and it is longer than wide; there are 3 pairs of lateral furrows on it, but they are mostly weaker near the axial furrows, and extend more than one-third across, so as to leave only a narrow median band down the centre; the first lateral furrow starts nearly from the anterior lateral angles of the glabella, making

* Kozłowski, *op. cit.*, 1923, p. 41.

the frontal lobe short and transverse ; there is a large median pit at the base of the frontal lobe which is covered with rather coarse, widely separated tubercles, but the rest of the glabella has smaller, more closely set, and low tubercles. The axial furrows are subparallel posteriorly, but diverge somewhat anteriorly. The fixed cheeks are swollen and smooth. The meso-occipital ring is rounded and bears no clear evidence of a nuchal spine.

Dimensions (61 S.A. Mus.) :—

Length of glabella	. . .	20.0 mm.
Width at front	. . .	18.5 „
„ at base	. . .	14.0 „

In the Albany Museum there is a specimen of a head-shield (71 Alb. Mus.) from the Winterhoek Range, labelled *Ph. pupillus* Lake, but it does not seem to belong to that species, for the right genal angle, which is preserved, is produced back into a long spine at least one-third the length of the head-shield, much as in *D. (Hausmannia) accola* Clarke,* from the Devonian of Brazil ; the pleuro-occipital furrow meets the marginal furrow at the base of the spine at an angle of about 75° ; there is a double row of median tubercles on the frontal lobe as in the type of *Ph. ceres* and *Ph. callitris* ; the anterior margin of the head is bluntly angulated, and only the third lateral furrows reach the axial furrows, though the two anterior pairs are well marked. Perhaps it is referable to *D. ceres*.

Phacops (Calmonia) callitris Schwarz.

1906. *Phacops (Cryphaeus) callitris*, Schwarz, Rec. Albany Mus., vol. i, pt. 6, p. 393, pl. x, figs. 2, 2a, 2b (29 Alb. Mus.).

Schwarz founded this species on two head-shields from the Cedarbergen (29 Alb. Mus., and 34 Alb. Mus.). The marginal supra-genal spines are clearly indicated in his figure (*op. cit.*, pl. x, fig. 2), but the eyes are represented as too small and placed too far forward, and the glabella is more quadrate. The frontal lobe has two parallel longitudinal rows of 4–6 small, low tubercles on its surface with a shallow groove between them, and similar tubercles are scattered irregularly on each side of them. The course of the facial suture is not clearly shown in Schwarz's figures ; the posterior branch at first runs out from the eye in a nearly straight line parallel to the posterior margin of the head-shield, but then bends back very

* Clarke, *op. cit.*, 1913, p. 101, pl. iv, figs. 9–18.

suddenly close to the lateral edge, which it cuts just in front of the supra-genal spine; the posterior margin and genal angle up to the spine form a continuous curve, the spine being directed outwards. This species may certainly be referred to the subgenus *Calmonia*, and appears to be allied to *C. signifer* Clarke.* There is a small head-shield of this species (I 4955, Brit. Mus.) from the Cedarberg in the British Museum.

It may be that Salter's *Ph. caffer* "young" (*op. cit.*, pl. xxv, fig. 10) belongs to this species rather than to *Ph. Lakei* sp. nov., under which it is here described (see p. 154).

Clarke † established the genus *Calmonia* for the group of species typified by his new Brazilian species *C. signifer*, and he regarded it as falling within the present author's group, *Metacryphaeus*, ‡ which was undoubtedly a composite assemblage of somewhat heterogeneous forms, and the name can only be used in a broad sense to include several subgenera or genera. Thus Clarke puts in it *Pennaia* and *Proboloides* as well as *Calmonia*, and is inclined to ascribe to it also the blind genus *Typhloniscus*. Kozłowski § regards *Calmonia*, *Pennaia*, and *Proboloides* as subgenera of *Acaste*, and even includes in this genus *Phacopina*, *Typhloniscus*, and *Anchiopella*. Clarke instituted a main division, which he termed *Mesembria*, to include nearly all the Phacopidae of the austral fauna, and in this division he recognised two subdivisions, *Metacryphaeus* and *Anchiopella*. *Dalmanites* and *Cryphaeus* of the latter were kept apart by Clarke as separate genera, but Kozłowski § puts *Cryphaeus* as a subgenus of *Dalmanites*, and Clarke || himself states that "it has no higher generic value than other subdivisions of *Dalmanites*."

Phacops (Calmonia) impressus, Lake.

1904. *Phacops impressus*, Lake, Ann. S. Afr. Mus., vol. iv, pt. 4, p. 209, pl. xxv, figs. 1 (43 S.A. Mus.), 2 (50 S.A. Mus.).

Lake (*op. cit.*) thought that one of the specimens of a nearly complete individual, figured by Salter (*op. cit.*, pl. xxv, fig. 13, 11291 Brit. Mus.) as belonging to *Ph. caffer*, was referable to *Ph. impressus*, but more probably this is a *Pennaia*; he also regarded it as probable that

* Clarke, "Foss. dev. Parana," 1913, p. 121, pl. vi, figs. 1-12; pl. vii, figs. 20, 21.

† Clarke, *op. cit.*, 1913, pp. 121, 152, 153.

‡ Reed, Geol. Mag., Dec. v, vol. iv, 1907, p. 168.

§ Kozłowski, *op. cit.*, 1923, pp. 30, 32, 41.

|| Clarke, *op. cit.*, 1913, p. 156.

it was the form referred to by Salter as *Phacops* sp. 3. Lake's figured specimens are from Gamka Poort, and are in the South African Museum (43 and 50 S.A. Mus.); the first figured one (43) consists of a nearly-complete much compressed, and partly-enrolled specimen, of which the head is in a very poor state of preservation, but the second (50) is a pygidium, and Lake clearly bases his species mainly on its characters. It is certainly a true and typical member of *Calmonia*, and is more closely allied to *C. subseciva* Clarke * of the Brazilian Devonian rather than to *C. signifer* Clarke, or its variety *micrischia*.† The pygidium and thorax of another specimen in the same Museum (65 S.A. Mus.) seem practically indistinguishable from *C. subseciva*. One of the characteristic features of the pygidium in both these species is that the pleurae are flattened, of regular width, have a weak median instead of a diagonal furrow (sometimes only present in the outer half), and do not reach the margin. The margin of the pygidium in Lake's specimen (43 S.A. Mus.) shows traces of 3-4 short spines, but Lake says that the number of these is uncertain. The eyes of *Ph. impressus* have 26-30 vertical rows of lenses, and the middle rows contain 8-10 lenses; the eyes themselves are large, and reach from the first to the third lateral furrows of the glabella. There is a pygidium (11299 Brit. Mus.) in the British Museum from the Gydo Pass, showing the same characters as Lake's types from Gamka Poort, and two head-shields (52061 Brit. Mus.), also from the Gydo Pass, showing the large eyes, may probably be referred to it. In a complete but crushed specimen (2556 Alb. Mus.) in the Albany Museum from the type locality, Gamka Poort, the genal angle possesses a short lateral spike, as in *C. signifer* Clarke; the large eyes show about 26 rows of lenses, with 8-10 in the middle rows; the margin of the pygidium seems to be entire and devoid of spines.

Phacops (Calmonia) impressus Lake, var. nov. *vicina*.

(Pl. XI, fig. 8.)

Head-shield transversely semicircular, with front end projecting and angulated obtusely, very gently convex; genal angles produced slightly backwards, bluntly pointed; rostral shield triangular, broad, projecting in front. Glabella broad, subtrapezoidal, widening slightly anteriorly, not inflated; first lateral furrows represented by shallow, isolated pits, very faint or obsolete; second lateral furrows represented

* Clarke, *op. cit.*, 1913, p. 126, pl. vii, figs. 1-10.

† *Ibid.*, p. 124, pl. vi, figs. 13-16.

by short, isolated, deep, transverse, oval pits, not connected with axial furrows; basal furrows stronger and deeper, with outer ends curved forwards and uniting with axial furrows. Meso-occipital furrow strong at sides. Cheeks triangular, with rounded, well-defined, lateral border and narrow doublure; eyes large, close to glabella at anterior end, extending from first lateral furrows to behind basal furrows.

Thorax of 10 or 11 segments; axis wide, cylindrical, each axial ring having distinct lateral swellings. Pleurae broad, somewhat expanded at ends, with rounded fulcrum at about one-third their length, and extra fulcral portion curving back and then forwards to end in blunt truncated tips; diagonal pleural furrow strong, sigmoidal.

Pygidium broadly semicircular, gently convex; margin entire, except for 1 or 2 small, very short, triangular denticles corresponding to first (?) and second pleurae. Axis subconical, annulated to blunt tip with 8-10 rings; lateral lobes gently convex, composed of 5-6 flattened pleurae, corresponding to the anterior axial rings, and ending a little distance inside edge of pygidium; each pleura with fine median furrow for its whole length; interpleural furrows strong, deep, ending inside undefined, smooth, marginal band, without marginal furrow. No definite border. Surface of trilobite covered with small tubercles or coarse granulations.

Dimensions (418 Kimb. Mus.):—

Length of head-shield	.	.	c. 14 mm.
Width „ „	.	.	c. 27 „
Length of thorax	.	.	23 „
Width of axis of thorax	.	.	c. 10 „
Length of pygidium	.	.	10 „
Width „ „	.	.	c. 19 „

Remarks.—The specimen from which the above description has been drawn up is in the M'Gregor Museum, Kimberley, and was collected at Gamka Poort. It consists of an entire individual, with the exception of the anterior part and left side of the glabella and head-shield, the occipital ring, and the first 5-6 thoracic pleurae on the left side which have been broken off. Apart from the curious curvature of the basal furrows, causing the conjoint first and second lateral lobes of the glabella to have a rounded external outline and the larger eyes, there seem to be no distinctive characters by which we can separate it from *Ph. impressus*, which, as above remarked, is closely allied to the Brazilian *Calmonia subseciva* Clarke.*

* Clarke, *op. cit.*, 1913, p. 126, pl. vii, figs. 2-10.

Of European allied species we may mention "*Acaste*" *Henni* Richt.* and "*Ac.*" *Schmidti* Richt.† of the Upper and Lower Coblenzian.

Phacops (Calmonia) ocellus, Lake.

1856. *Phacops africanus* Salter (pars), Trans. Geol. Soc., ser. 2, vol. vii, p. 218, pl. xxv, fig. 2 (11284 Brit. Mus.); fig. 6 (14956 Brit. Mus.); fig. 9 (14957 Brit. Mus.), *non cet.*

1904. *Phacops ocellus* Lake, Ann. S. Afr. Mus., vol. iv, pt. 4, No. 9, p. 207, pl. xxiv, fig. 9 (14956 Brit. Mus.); figs. 10a, b (14957 Brit. Mus.).

The characters of this species were clearly described by Lake, but he founded it on the head-shield from the Cedarberg (14956 Brit. Mus.) which Salter also figured (*op. cit.*, fig. 6). Schwarz ‡ does not think that Lake was justified in associating with it the thorax and pygidium (14957 Brit. Mus.) from the same locality. The head is almost indistinguishable from Schwarz's *Ph. callitris*,§ but I cannot see any trace of supra-genal spines in Salter's specimen, and the genal angles are certainly rounded and not produced back into genal spines as Salter dotted in. Clarke || figures specimens from the Falkland Isles as *Ph. (Calm.) ocellus* Lake, but his head-shields are rounded in front, the glabella is not angulated as in Lake's type, and is also broader, more rounded, and subquadrate in shape; the pygidium, as Clarke remarks, bears 6 pairs of marginal spines instead of 4 (or possibly 5), as Lake's type (14957 Brit. Mus.) shows, and altogether a different species seems to be represented.

The thorax and attached pygidium (11284 Brit. Mus.) from the Gydo Pass which Salter (*op. cit.*) gave as his second example and figure of *Ph. africanus*, was not referred to any species by Lake, but it seems undoubtedly to belong to some species of *Calmonia*, and though the marginal spines on the pygidium which Salter figured are no longer visible, yet we cannot fail to note its resemblance to Lake's *Ph. ocellus*, and a more precise description than Salter furnished is desirable. There are 8 segments of the thorax preserved. The axis is broad and convex, subcylindrical, and one-third the width of

* Richter, Jahrb. preuss. geol. Landesanst., Bd. xxxvii, 1916, Heft i, p. 252, t. xxv, figs. 13-16; t. xxvii, figs. 1-3.

† *Ibid.*, p. 252, t. xxvii, figs. 4-6.

‡ Schwarz, Rec. Alb. Mus., vol. i, pt. 6, 1906, p. 397.

§ *Ibid.*, p. 393, pl. x, figs. 2, 2a, 2b.

|| Clarke, *op. cit.*, 1913, p. 129, pl. v, figs. 10-15.

the thorax, with decided lateral swellings on each ring. The pleural lobes are strongly arched down; the pleurae have the fulcrum very close to the axis, being only at about one-fifth (or less) their length; the diagonal pleural furrow is strong, and the tip of the pleura is bluntly truncate. The pygidium is semi-oval, being rather longer than wide, and the axis, which is conical and tapers rather rapidly, is annulated nearly to its tip with 7 rings and has a small terminal piece; the pleural lobes consist of 5 pairs of well-marked, flattened pleurae, and a faint, small, sixth pair; the pleural furrow on each is median not diagonal, and strongest near the border; the pleurae and furrows do not reach the margin, and the narrow convex doublure is seen as a concave impression round the margin. There are no marginal spines now visible in the specimen, the edge being simple and entire, as in *Calmonia subseciva* Clarke * (though Salter's figure shows 4 pairs), but they may have been destroyed in course of time since the specimen was drawn, and their presence would make it resemble *C. signifer* Clarke, † from Ponta Grossa, especially the variety *micrischia* Clarke; ‡ indeed this Brazilian species seems in every respect indistinguishable in the characters of the thorax and pygidium.

Phacops (Calmonia) Lakei sp. nov.

(Pl. IX, figs. 4, 5.)

? 1856. *Phacops caffer* Salter (pars), Trans. Geol. Soc., ser. 2, vol. vii, pl. xxv, fig. 10 (11289 Brit. Mus.), *non cet.*

Head-shield transversely semicircular; genal angles rounded or bluntly pointed, subrectangular; border broad, rounded, convex, definitely marked off by strong marginal furrow, much narrowed in front of glabella (where it is provided with 2-3 obtuse elevated tubercles on each side of middle line?). Glabella very broad, rounded, trapezoidal, widening anteriorly, sides very slightly arched outwards; 3 pairs of well-marked lateral furrows; anterior pair very far forward, straight, or slightly undulating, long, oblique, arising close behind lateral angles of frontal lobe; second pair represented by shorter, isolated, horizontal, or slightly wavy furrows, not reaching axial furrows; basal furrows longer, deep, nearly horizontal, or concave forwards, reaching axial furrows and nearly uniting across middle; frontal lobe not independently swollen, transverse, short, about one-

* Clarke, *op. cit.*, 1913, p. 126, pl. vii, figs. 2-10.

† *Ibid.*, p. 121, pl. vi, figs. 1-12; pl. vii, figs. 20, 21.

‡ *Ibid.*, p. 124, pl. vi, figs. 13-16.

third length of glabella; basal lobes narrow, somewhat swollen; meso-occipital ring rounded, convex, simple, widest in middle; meso-occipital furrow strong, arched forward, of uniform depth. Cheeks forming spherical triangles, not swollen; pleuro-occipital furrow strong, horizontal, meeting marginal furrow at about 75° ; pleuro-occipital ring widening laterally. Eyes large, reaching from first lateral furrow to middle of second lateral lobe, semicircular, situated close to glabella, with swollen edge to eye lobe. Facial suture with short anterior branch and strongly arched posterior branch cutting lateral margin just in front of small supra-genal spine. Surface of head-shield finely and closely tuberculated or coarsely granulated. Thorax with slowly-tapering, broad, convex axis, the rings without distinct lateral swellings. Pleurae with well-marked fulcrum at about one-third their length, outside which each pleura is bent down and curves gently back and then slightly forwards to end in a free, short, subcentral, subfalcate point; pleural furrow strong, diagonal, not reaching tip. Pygidium semicircular, gently convex; margin entire. Axis convex, conical, tapering rather rapidly to blunt tip not reaching margin, annulated with 7-8 complete rings for whole length. Pleural lobes gently arching down on each side, composed of 5-6 simple flattened pleurae gently curved back, each with faint, median, pleural furrow. Surface of thorax and pygidium finely tuberculated, the tubercles on the pygidial lateral lobes arranged in a line along the length of the pleurae with some regularity.

Dimensions (232 Cape Univ.) :—

Length of head-shield . . .	16.5 mm.
Width of „ . . .	34.5 „
Length of glabella . . .	13.0 „
Width of „ at front . . .	15.5 „
„ „ „ at base . . .	11.5 „
Length of eye . . .	6.0 „

Remarks.—This species seems to agree better with *Ph. convexus* Ulrich * than with *Ph. ocellus* Clarke (*non* Lake), in the shape of the glabella, lateral furrows, characters of cheeks, position of eyes, shape of genal angles, and well-defined lateral border to the head-shield. But the eyes are larger, and the presence of the supra-genal spine indicates its reference to *Calmonia*, and suggests affinity with *Ph. (Calm.) signifer* Clarke, especially the variety *micrischia* † from Brazil.

* Ulrich, *op. cit.*, 1893, p. 16, t. i, figs. 9, 10, ? 11.

† Clarke, *op. cit.*, 1913, p. 124, pl. vi, figs. 13-16.

Several isolated head-shields (232, 257, 147 Cape Univ.) occur in the collection of the Cape University from Touws River Road, and there is one small complete individual from the same locality (138 Cape Univ.) measuring 14.5 in length from which the characters of the thorax and pygidium have been determined.

The small perfect head-shield (11289 Brit. Mus.) which Salter figured (*op. cit.*, pl. xxv, fig. 10) as a young individual of *Ph. caffer* and Lake (*op. cit.*, p. 210) accepted as such, probably belongs to our new Bokkeveld species, but no supra-genal marginal spine is visible, and the marginal furrow is weaker and less distinct. The course of the lateral furrows on the glabella is not well shown in Salter's figures, but they agree better with *Ph. Lakei* than with *Ph. ocellus*.

As above mentioned, Schwarz believed that the thorax and pygidium, which Lake attributed to the head-shield on which he founded the species *Ph. ocellus*, belong to another species, and from the occurrence of apparently identical portions of the trilobite in the same state of preservation and at the same locality as the head of *Ph. Lakei*, we may suspect that Schwarz was correct. But the evidence is at present inconclusive and unsatisfactory.

As regards the head-shield of *Ph. Lakei*, there is a considerable resemblance to the European species "*Acaste*" *Henni* Richter* of the Upper Coblenzian, but the pygidium in the Bokkeveld species has the segmentation better developed. Indeed those austral species of *Calmonia*, which carry no lateral spines on the margins of the pygidium, appear to be identical in all essential characters with the Lower Devonian group of "*Acaste*" in Europe.

Phacops (Calmonia ?) pupillus, Lake.

? 1856. *Phacops (Cryphaeus) africanus* Salter (pars), Trans. Geol. Soc., ser. 2, vol. vii, p. 218, pl. xxv, fig. 8 (11288 Brit. Mus.), *non cet.*

1904. *Phacops pupillus* Lake, Ann. S. Afr. Mus., vol. iv, pt. 4, p. 203, pl. xxiv, fig. 1 (59 S.A. Mus.).

This species was founded on a solitary specimen of an imperfect head-shield from Gamka Poort in the South African Museum (59 S.A. Mus.), but Lake believed that one of the head-shields referred by Salter to *Ph. africanus* (*op. cit.*, pl. xxv, fig. 8) also belonged to it. The true subgeneric position of this specimen is uncertain, but

* Richter, Jahrb. preuss. geol. Landesanst., Bd. xxxvii, 1916, Heft i, p. 252, t. xxv, figs. 13-16; t. xxvii, figs. 1-3.

it may belong to *Calmonia*, though the spinose genal angles are rather unusual.

Phacops (Pennaia) Gydowi, Schwarz.

(Pl. IX, figs. 7, 7a ; Pl. XI, fig. 2.)

1906. *Phacops (Cryphaeus) Gydowi*, Schwarz, Rec. Albany Mus., vol. i, pt. 6, p. 396, pl. x, figs. 3, 3a, 3b (28 Alb. Mus.), 3c (26 Alb. Mus.).

In 1906 Schwarz figured a detached head-shield (28 Alb. Mus.) from the Gydo Pass, with some thoracic segments (26 Alb. Mus.) on which he founded this species, but there is another complete specimen (25 Alb. Mus.) in the same collection which was not figured, showing the genal angles to be rounded. There is a good head-shield with 7 thoracic segments attached from the Cockscomb Mountains in the Bloemfontein Museum, and a specially fine complete individual (1167 S.A. Mus.) from Boschluis Kloof, Prince Albert, in the South African Museum, and another from Ceres in the Maritzburg Museum. This material allows us to amplify the original description.

The large eyes, which are well preserved in the specimens at Bloemfontein and Maritzburg, consist of 30-32 vertical rows of lenses with 12-14 lenses in the centre rows. As in the typical species of *Pennaia*, it is the basal glabellar furrows which are the strongest. The genal angles are broadly rounded. The surface of the head-shield, including the doublure, is covered with rather widely-spaced, small, round, low tubercles, with minute granulations between them, and similar tubercles are spread over the thorax. The pleuro-occipital furrow is slightly concave forward and meets the weaker marginal furrow at about 75°. The facial sutures have the posterior branches nearly horizontally directed outwards, but with a slightly sigmoidal course, and cut the lateral margin of the head-shield level with the basal glabellar furrows.

The thorax has rather a wide semi-cylindrical axis, with slight nodular lateral swellings on each axial ring. The pleural lobes are not wider than the axis, and have the pleurae strongly bent down at the fulcrum, which is situated at about two-fifths their length, and the extra fulcral portion is strongly curved backwards and then forwards to its tip, which is truncate, and has the posterior corner angulated or furnished with a very small point, as Schwarz observed ; the pleural furrow is strong, nearly straight, and diagonal, and there is a large bevelled articular facet for enrolment. The pygidium is transversely semi-elliptical or semicircular in shape, and has a slowly-

tapering, conical axis, reaching the margin and composed of 6 complete rings and a small terminal joint; on the lateral lobes there are 5 pairs of broad flattened pleurae, corresponding to the axial rings (with traces of a very narrow, short, sixth pair), separated by strong, straight furrows not reaching the margin; each pleura bears a very faint, short, straight, non-median furrow near its outer extremity. The lateral margins of the pygidium are provided with 3 pairs of very short, broad, triangular spinose projections, corresponding to the first three pleurae, but behind them the margin is entire and simply rounded.

Dimensions :—

	(Bloemfontein.)	(Maritzburg.)	(1167 S.A. Mus.)
Length of head-shield .	28 mm.	25 mm.	19 mm.
Width „ „ at base.	c. 46 „	c. 40 „	24 „
Length of glabella .	23 „	22 „	..
Width „ „ at base	15 „	14 „	12 „
„ „ „ at front	..	18 „	..
Length of eye . .	10 „	..	7 „
„ „ thorax . .	..	c. 43 „	32 „
„ „ pygidium .	..	c. 14 „	13 „
Width „ „ . .	..	c. 16 „	19 „
„ „ axis at front .	..	..	12 „

Remarks.—This species is very closely allied to *Pennaia pauliana* Clarke * of the Devonian of Ponta Grossa, but it differs in the glabella being rather narrower and longer, the eyes larger, and the pleural furrows on the pygidium only being clearly developed near the outer extremities of the pleurae. The ornamentation also appears to be rather different, and the shape of the extremities of the thoracic pleurae is peculiar to our Bokkeveld species. It is probable that “*Acaste*” *Verneuili* (D’Orb.) from Bolivia † is allied.

Phacops (*Pennaia*) *africanoides* nom. prop. (= *africana* Shand, non Salter).

1914. *Pennaia africana* Shand, Trans. Geol. Soc. S. Africa, vol. xvii, p. 24, pl. vi, figs. 1-4 (E 416 Stell. Mus.).

The specimen which Dr Shand described from Osplaats in the Hex

* Clarke, *op. cit.*, 1913, p. 133, pl. v, figs. 18-25.

† Kozłowski, *op. cit.*, 1923, p. 48, pl. iv, figs. 1-6.

River Valley under the name *Pennaia africana* is in the Stellenbosch Museum (E 416), and there is another good head-shield of it in the same collection. Apart from the pygidium there is not much resemblance to the genotype *P. pauliana* Clarke,* for the head-shield might well be referred to *Calmonia*, and much resembles that of *Ph. (Calm.) Lakei* sp. nov. above described. The thoracic characters also agree closely with typical members of *Calmonia*. The pygidium alone seems to possess the characters of *Pennaia*, but the type specimen is not perfect and the character of the posterior margin is uncertain.

It is unfortunate that the name *africana* was applied to this species, as *Pennaia* is only a subgenus of *Phacops*, and Salter's *Ph. africanus* is a member of the subgenus *Anchiopella*. It appears therefore desirable to alter the name, and we may suggest the substitution of *africanoides* to avoid confusion, while retaining a semblance of Shand's designation.

Phacops (Phacopina) hiemalis sp. nov.

(Pl. X, fig. 8 ; Pl. IX, fig. 12 ? .)

Head-shield semi-parabolic, moderately convex from side to side, with its median portion angulated and projecting in front, the anterior margin being excavated on each side of the glabella so as to make a slight re-entrant angle on the edge. Glabella gently convex, subcylindrical, longer than wide, widening very slightly anteriorly, with straight sides and weakly-angulated front end projecting in front of cheeks ; frontal lobe unusually long, nearly half the total length of glabella, not projecting laterally ; first and second lateral furrows nearly obsolete ; first furrows situated far back, very faintly impressed, directed very obliquely backwards ; second lateral furrows nearly horizontal, very feebly indicated ; third lateral furrows deep, wide, slightly oblique, isolated, short, faintly connected across base of glabella, and scarcely traceable into axial furrows. Axial furrows strong, straight, slightly divergent. Facial sutures with anterior branches long, subparallel, sharply bending in at frontal angles of glabella to meet in middle at angle of about 120° ; posterior branches horizontal, gently sigmoidal, parallel to posterior edge of head-shield. Meso-occipital ring rounded, thickened and swollen in middle. Cheeks subtriangular, longer than wide, with strong, broad, pleuro-occipital furrow and shallower lateral marginal furrow separating off well-rounded border. Genal angles blunt, sharply rounded, with lateral and posterior edges of head-shield inclined nearly at

* Clarke, *op. cit.*, 1913, p. 133, pl. v, figs. 18-25.

right angles. Pleuro-occipital ring widening outwards to genal angles. Eyes large, about $\frac{1}{4}$ length of glabella, elevated on more or less swollen inner portion of cheeks, situated at about one-fifth the width of the glabella from its sides and behind its middle length. Anterior border of head-shield in front of glabella narrow, but deep, having a thick, rounded edge, steeply inclined, with a few larger tubercles on its under surface. Rest of surface of head-shield coarsely granulated.

Dimensions :—

Length of head-shield	.	.	34.0 mm.
Width of	„	.	50.0 „
Length of glabella	.	.	26.5 „
Width	„	„ at base	18.5 „
„	„	„ at front	22.0 „

Remarks.—The unique specimen (In. 24100) of a head-shield on which this species is founded was obtained from the Winterhoek Mountains near Mount Cockscomb, Uitenhage, and presented to the British Museum in 1858 by Dr. Atherstone. It is in rather an unusual state of preservation, and the curious wrinklins on the surface of the whole head-shield seem due to the natural shrivelling of the epidermal cuticle of the carapace. In general characters it much resembles *Phacopina devonica* Ulrich,* which occurs in the Bolivian Devonian, but the glabella is more cylindrical, the first lateral furrows rather further back, the front margin is more angulated, and the meso-occipital ring more thickened. *Ph. brasiliensis* Clarke † from the Maecuru Sandstone, which is taken by M'Learn ‡ as the genotype of *Phacopina*, is regarded by Kozłowski as allied to *Ph. devonica*, but Clarke § considers it as belonging to the same group as *Ph. (Phacopidella) correlator* Clarke || from the Gaspé and Oriskany Sandstones, while he puts *Ph. devonica* in the present author's group or division *Metacryphaeus*. Kozłowski, ¶ however, maintains that the diagnosis does not fit it.

Dienst ** has attributed the Coblenzian species, *Acaste Schmidtii*

* Ulrich, *op. cit.*, 1893, p. 21, t. i, figs. 14a, b, 15; Kozłowski, *op. cit.*, 1923, p. 49, pl. iv, figs. 7-14.

† Clarke, *Archiv Mus. Nac. Rio de Janeiro*, vol. x, 1890, p. 16, t. i, fig. 1.

‡ M'Learn, *Ottawa Naturalist*, vol. xxxii, 1918, p. 33.

§ Clarke, *Mem. 9, New York State Mus.*, pt. 1, 1908, p. 226, pl. x, figs. 17, 18.

|| Clarke, "Foss. devon. Parana," 1913, pp. 152, 153.

¶ Kozłowski, *op. cit.*, 1923, p. 51.

** Dienst, *Jahrb. k. preuss. geol. Landesanst.*, Bd. xxxiv, Heft 1, 1914, p. 545.

Richter, to the subgenus *Phacopina*, but the correctness of this reference may be questioned.

There is a pygidium (243 Cape Univ.) from Touws River Road, Upper Hex River Valley, in a different state of preservation to the above-described head-shield, but it may possibly belong to the same species, on the strength of its resemblance to the pygidium of *Ph. devonica* figured by Kozłowski* from Bolivia. Our specimen is partly hidden by matrix, but it is seen to be subtriangular in shape and convex from side to side and pointed behind; the axis is broad, subcylindrical, very slightly decreasing in width to its blunt termination, and is annulated for its whole length by 9 complete simple rings; the pleural lobes are composed of 6-7 well-rounded, convex, raised, simple, unfurrowed pleurae, gently curved back, but the last 2-3 are weak, indistinct, and subparallel; all the pleurae end abruptly within the edge of the pygidium, but there is no definite border. The interpleural furrows are strong and deep.

Dimensions :—

Length of pygidium	c. 23 mm.
Width of „	29 „
„ of axis at front end	13 „
Length of axis	19 „

Phacops (Bouleia ?) Sharpei sp. nov.

(Pl. IX, fig. 6; Pl. X, fig. 9.)

Pygidium transversely semicircular; margin entire. Axis broad, conical, tapering rather rapidly to blunt tip, not reaching posterior edge, about one-third the width of pygidium at anterior end, gently convex, annulated for whole length with 7-8 complete rounded rings, separated by wide intersegmental furrows. Pleural lobes very slightly arched, with fulcrum situated at less than one-third their width on front edge, and with long, oblique, extra-fulcral edge meeting posterior margin at lateral angle level with fourth or fifth axial ring; pleurae 6, widely separated, simple, corresponding with axial rings, very slightly curved, strongly elevated, convex, dying out some distance inside margin, leaving an undefined rather wide border one-third or one-fourth the width of the pleural lobes; interpleural furrows deep, as wide as pleurae, rounded.

Surface of whole pygidium ornamented with close, very coarse granulations.

* Kozłowski, *op. cit.*, 1923, pl. iv, figs. 13, 13a.

Dimensions (198 Cape Univ.) :—

Length of pygidium	.	.	14 mm.
Width (max.) of pygidium	.	.	26 „
Length of axis	.	.	11 „
Width of axis at front end	.	.	9 „

Remarks.—There is only one complete specimen of a pygidium (198 Cape Univ.) in the collection of the Cape University from Touws River Road, Upper Hex River Valley, and an imperfect smaller pygidium (I 858 Brit. Mus.) in the British Museum from the Keurbooms River, Plettenberg Bay, the latter only showing part of the axis and the posterior portions of the pleural lobes. There is no marginal furrow marking off the border, which, however, posteriorly, forms a definite, smooth, wide band outside the ends of the pleurae. The pleurae are simple, and show no clear trace of any furrow. We may compare the pygidium of the Bolivian species *Phacops* (*Bouleia*) *Dagincourti* Ulrich,* with this Bokkeveld species, which it resembles in general shape, number of segments, and simplicity of the pleurae.

Note.—There are in the British Museum two small complete trilobites labelled “*Phacops latifrons* Bronn. Devonian, Cape of Good Hope. 44976. Morris Coll. Bt. of Krantz.” They are in a completely different state of preservation to the other undoubted Bokkeveld specimens, and it has been suggested with much probability that there has been some mistake in the locality, and that they come from the Devonian of the Eifel. They represent two distinct species, both of which bear a certain affinity to *Ph. rana* Green, and to *Ph. Salteri* Kozłowski,† which occurs in the Devonian of South America. But it does not seem likely that either of these British Museum specimens came from South Africa, and a description of them is therefore unnecessary.

Typhloniscus Baini, Salter.

1856. *Typhloniscus Baini*, Salter, Trans. Geol. Soc., ser. 2, vol. vii, p. 221, pl. xxv, fig. 14 (11292 Brit. Mus.).

1904. *Typhloniscus Baini* Lake, Ann. S. Afr. Mus., vol. iv, pt. 4, p. 213, pl. xxv, figs. 8, 9 (63 S.A. Mus.).

Lake gave rather a short description of this species and did not

* Ulrich, Neues Jahrb. f. Miner., Beil. Bd. 1892, p. 23, pl. i, figs. 16a-c; Kozłowski, *op. cit.*, 1923, p. 56, pl. vi, figs. 7. 7a, b, 8, 8a-c.

† Kozłowski, *op. cit.*, 1923, p. 54, pl. vi, figs. 1-6.

mention that there is a coarse tuberculation all over the glabella and cheeks as seen in No. 1659 S.A. Mus., and in others (117, 120) in the collection of the Cape University, for in the specimen (41 S.A. Mus.) which he figured from Gamka Poort the surface is rubbed.

In another specimen of the thorax and pygidium (458 S.A. Mus.) from Koudeveld Berg, the pygidium is seen to be semicircular with an entire margin; there are +6 rings on the axis, and 5-6 pleurae on the lateral lobes. In the British Museum there is a thorax showing 10 segments attached to an imperfect pygidium (11302 Brit. Mus.) and named by Salter. This pygidium is better preserved and merits some description: the axis only shows 4 rings, of which the first 2 only are distinct, and the lateral lobes are composed of only 4 pleurae, of which the first 3 pairs are rounded, strongly convex, gently arched back, and subequal, but the fourth pleurae are much smaller and shorter, and run straight back nearly parallel. There is a good head-shield in the Albany Museum (2561 Alb. Mus.) which exhibits some interesting and peculiar features, a narrow extra- or infra-marginal band running round the anterior edge in front of the narrower rounded border; it seems to arch forward on each side of the middle part, which is reduced in width and recessed, and it possesses on its outer edge a row of small tubercles of about 6 on each side, and on its inner edge a row of small pits with raised lips lying in the groove separating it from the border, and in more than one place there seems to be a fine radial pitting on this curious infra-marginal band or doublure. The head-shield to which it is attached measures 17 mm. in length and 30 mm. in width, and the band is only 2 mm. wide in its broadest part. Its nature is somewhat doubtful.

Homalonotus (Burmeisteria) Herscheli, Murchison, emend.

1839. *Homalonotus Herscheli* Murchison, Silur. Syst., p. 652, pl. vii, *bis.*, fig. 2.
1856. *Homalonotus Herscheli* Salter (pars), Trans. Geol. Soc., ser. 2, vol. vii, p. 215, pl. xxiv, figs. 1a-c (11276, 11294 Brit. Mus.), 2 (11277 Brit. Mus.), 6 (11281 Brit. Mus.), 7a-d (11282 Brit. Mus.) (*non* figs. 3, 4, 5, 8). [Fig. 1 is a restoration from specimens Nos. 11294, 11276 Brit. Mus.]
1904. *Homalonotus Herscheli*, Lake (pars), Ann. S. Afr. Mus., vol. iv, pt. 4, p. 214, pl. xxvi, figs. 3a, b (30 S.A. Mus.) *non* figs. 1, 2.

1906. *Homalonotus Herscheli* Schwarz (pars), Rec. Albany Mus., vol. i, pt. 6, p. 383, pl. ix, fig. 3 (*non* pl. viii, fig. 8).

? 1906. *Homalonotus lex* Schwarz (pars), *ibid.*, p. 389, pl. ix, figs 4*a*, *b* (1462 and 1 Alb. Mus.).

1918. *Homalonotus (Burmeisteria) Herscheli*, Reed, Geol. Mag., Dec. vi, vol. v, pp. 314, 324.

Murchison's original specimen consists of a thorax and pygidium from the Cedarberg, and he was apparently ignorant of the head-shield. There has been much confusion and irregularity in the use of this specific name. As mentioned by the present author (1918, *op. cit.*), Salter's figures represent more than one variety or species, and the typical form of the head-shield corresponding with his description is that illustrated by his figures 1*a-c* (11276 Brit. Mus.); the occipital ring, however, is missing in this specimen, and has been restored from another head-shield (11294) from the same locality, Leo Hoek, in the same collection, and it shows precisely the same characters in the glabella and other parts as the type. Salter's description of the characters of the glabella is sufficient, except that it should be added that the anterior end is rounded, not abruptly truncate as in some allied species or varieties. The facial sutures unite in front on the upper surface of the head-shield in a broad ogive, meeting in the middle in a point, and not forming a simple continuous curved commissure. The apiculus of the rostral shield is a rounded, hook-like, pointed projection, curving downwards.

These features are well seen in the specimen numbered 52053 from Leo Hoek in the British Museum, while in the specimen No. 11294 (8) in the same collection the occipital ring is preserved and shows the characters illustrated by Salter in his figures 1*a*, 1*b*; there is a small median tubercle on the meso-occipital portion, with another small one on each side just inside the axial furrows, while on the pleuro-occipital portion there are 3 tubercles or spine-bases on its outer part, successively increasing in size; (these are well seen in a specimen (1432 Alb. Mus.) in the Albany Museum); probably the outermost two rose into short spines, but they are broken off. No other tubercles or spines occur on the head-shield, the whole of which is covered with a fine ornamentation consisting of rather large, subequidistant, well-spaced granules of equal size, between which is a very minute, close, general granulation. There are subcircular, depressed, well-marked paraglabellar areas, slightly swollen in the middle, and definitely circumscribed, on each side of the basal lobes of the glabella, which they slightly excavate, and they have only a minute granulation on them,

finer than that on the rest of the head-shield. Salter termed them the "oval flattened spaces." The ogival junction of the facial sutures in the middle in front of the glabella forming an obtuse angle at the base of the apiculus is a characteristic of the species, and is well seen in a head-shield (66 Alb. Mus.) in the Albany Museum.

The pygidium (11282 Brit. Mus.) figured by Salter (*op. cit.*, pl. xxiv, figs. 7*a-d*) as belonging to *H. Herscheli*, has precisely the same ornamentation as the above-mentioned head-shields, and also possesses a small median tubercle on the axial ring like that on the meso-occipital ring and a similar lateral one on each side, except on the third ring, which seems to have none. The pleural lobes which are weakly separated from the axis (the axial furrows being only slightly impressed) are steeply inclined on each side, and show 12-13 well-marked pleurae corresponding with the axial rings which number 14-15, but the posterior part of the axis and pleural lobes are smooth, the segmentation being nearly or quite obsolete. The tip of the pygidium descends rather rapidly to the margin, as is shown in profile in Salter's figure, 7*b*, and is a characteristic feature. The end of the pygidium is acutely pointed. The strong transverse convexity, the pointed posterior end, the long triangular pointed terminal plate of the doublure, the ornamentation of the whole surface, and the obsolescence of the posterior segmentation are distinctive and typical characters of the species. On several of the pleurae a small tubercle occurs, but not at the same point.

Schwarz (*op. cit.*) tried to sort out Salter's and Lake's specimens from the published figures, but he was not altogether successful in the attempt, and he believed that several species had been included under the one name.

With regard to the thorax, which should be associated with the head-shields and pygidia above referred to *H. Herscheli*, the one figured by Salter (*op. cit.*, fig. 4) from Gydo Pass (11279 Brit. Mus.) is much like Murchison's original figure and Frech's *H. perarmatus*, which is here regarded as a variety. The tubercles (spine-bases) on the pleurae and axis seem too coarse and large to belong to the typical head-shields. But probably the two thoracic segments (11281 Brit. Mus.) represented by Salter's figure 6, having small lateral tubercles on the axis, belong to the type of head-shield which he figured.

Salter's figured specimen (11280 Brit. Mus.) of two thoracic segments (*op. cit.*, fig. 5) is probably referable to Lake's species *H. quernus* described below, and the pygidium (11283 Brit. Mus.) (*op. cit.*, fig. 8) probably belongs to *H. noticus* Clarke, var. nov. *africana* (see p. 184).

In the Stellenbosch Museum there is a good example (C 5) of a small head-shield (locality unknown), 31 mm. in length, agreeing in nearly all particulars with the second figured specimen (11277 Brit. Mus.) of Salter's plate (*op. cit.*, pl. xxiv, fig. 2), and it shows the lower surface of the anterior part of the head-shield very well. The distinctly upturned preglabellar area, the short unciform apiculus, the acutely triangular rostral shield, the broad plate-like doublure forming a large triangular shield on each side of the rostral shield but narrowing laterally very rapidly (as in *H. noticus* Clarke), the urceolate shape of the glabella, the 3 pairs of glabellar furrows, the paraglabellar areas, and the prominent eyes on the swollen cheeks are just as Salter illustrates, and a comparison with his figured specimen proves that they precisely agree. But there is no trace of a median tubercle or any other tubercle on the meso-occipital ring, and the pleuro-occipital portions are broken and missing. There is a median longitudinal ridge along the rostral shield bisecting its surface, which seems absent in Salter's type. Of more importance is the fact that the transverse union of the facial sutures is straight and shows no median angulation, though this also may be due to immaturity. The ornamentation of the surface seems to be indistinguishable from that of the typical *H. Herscheli*.

We may draw attention to the resemblance of the anterior part of the head-shield with its upturned snout, rostral shield, apiculus and doublure, to *H. noticus* Clarke,* from the Devonian of Brazil, but the glabella is quite different.

The species which Schwarz named *H. lex* (*op. cit.*, p. 389, pl. ix, figs. 4a, 4b) was founded on 3 large thoracic pleurae, and is a most unsatisfactory one, being imperfectly defined. It seems to be an unnecessary species, for the figured specimens may be probably attributed to *H. Herscheli*. The first figured (fig. 4a) and mentioned specimen (1462 Alb. Mus.) consists of only 3 thoracic pleurae, each having a pair of small tubercles inside the fulcrum, with an extra third tubercle on the second pleura. The tip of the pleurae, which Schwarz describes as pointed, is merely truncated. The second figured specimen, fig. 4b (1 Alb. Mus.), has a pair of lateral tubercles or spine-bases on nearly every axial ring of the thorax (which is convex), and also occasionally a small median one, while on each pleura there is a single large tubercle or pair of closely-placed small tubercles inside the fulcrum. On some of the axial rings of the pygidium of

* Clarke, *op. cit.*, 1913, p. 89, pl. i, figs. 1, 2; pl. ii, figs. 1-13. R. and E. Richter, *Centralbl. f. Miner., etc., Jahrg. 1917*, pp. 114-120, text-figs. 3a-c.

this specimen (of which Schwarz only figured from thoracic rings) there is likewise a pair of lateral tubercles. The fine ornamentation of the surface is like that of *H. Herscheli*.

Another fragment of a thorax (13 Alb. Mus.) consisting of 9 segments, has a pair of lateral spine-bases on each axial ring, regularly arranged, but none on the pleurae; the fine ornamentation consists of granules of two sizes as in *H. Herscheli*. In another (9 Alb. Mus.) the tubercles or spine-bases on the thorax are less regularly developed, and some of the pleurae carry one or two spine-bases. Thus we see that there is considerable variation in the number and disposition of the spine-bases, and it does not appear that we can attach primary importance to them, at any rate to those on the thorax.

H. Herscheli is the type of the section or subgenus *Burmeisteria*, and its characters have been discussed by the author on a previous occasion,* and a precise definition given.

Homalonotus (Burmeisteria) Herscheli, Murchison, var. nov.
rectisuturalis.

(Pl. X, figs. 3, 7.)

1904. *Homalonotus Herscheli* Lake, Ann. S. Afr. Mus., vol. iv, pts. 4, 9, pl. xxv, fig. 1 (29 S.A. Mus.).

There is one large, nearly perfect head-shield with the shell preserved in the collection of the Cape University (314 Cape Univ.) from Bokke Rivier, seventeen miles from Touws River, on the road to Ceres, which can hardly be separated specifically from *H. Herscheli*, but certainly constitutes a variety remarkable for the shortness and breadth of its glabella and other features. Internal casts of the head-shield of this form (7193 S.A. Mus.) look still more unlike the typical *H. Herscheli*. The head-shield is transversely semicircular, and is more or less convex from side to side. The glabella is subquadrate, wider than long, or as wide as long, scarcely urceolate, decreasing slightly in width anteriorly, with the frontal lobe scarcely expanding; the front end is truncated, but the lateral furrows are developed as in the typical form. In the well-preserved example from Bokke Rivier the basal lobes carry a weak, median, horizontal, transverse ridge, which does not seem due to an injury, as it is symmetrically developed on each side. The paraglabellar areas are subcircular and cut into the sides of the basal lobes. The cheeks are swollen, and their characters agree with the typical form. The facial sutures unite in front

* Reed, Geol. Mag., Dec. vi, vol. v, 1918, pp. 314, 324.

by a simple, transverse, scarcely-arched suture without any median angulation, and the rostral apiculus is very short, blunt, and broadly triangular, and bears small tubercles or large granules on it, as also on the rounded edges of the free cheeks where they are closely aggregated, whereas the general surface of the head-shield has only a fine general granulation, with small, sharp tubercles scattered about as in the type form. The marginal furrow to the free cheeks is obsolete or very shallow and broad. In one specimen (C 6 Stell. Mus.) from an unknown locality, the pleuro-occipital ring is preserved and is seen to widen and swell up laterally and bear 2-3 large spine-bases at about half its length. The genal angles are broadly rounded. The meso-occipital ring is smooth.

Dimensions :—

	(314 Cape Univ.	(7193 S.A. Mus.)	(C 6 Stell. Mus.)
Length of head-shield (minus occipital ring)	55.0 mm.	42.0 mm.	50.0 mm.
Width of head-shield .	92.0 „	60.0 „	c. 80.0 „
Length of glabella .	41.0 „	27.0 „	31.0 „
Width „ at base	44.0 „	31.0 „	35.0 „
„ „ at front	37.0 „	24.0 „	27.0 „

In those specimens of the head-shield preserved only as internal casts, such as one (7193 S.A. Mus.) from the Cold Bokkeveld, and another (C 6 Stell. Mus.) from an unknown locality, the lateral furrows on the glabella are indistinct and the ornamentation is, of course, not visible. An imperfect head-shield in the Albany Museum (2552 Alb. Mus.) shows not only the transverse straight suture and apiculus, but also the rostral shield on the inferior surface. This rostral shield is almost an equilateral triangle, and there is no median ridge running back from the apiculus. The general ornamentation of the head-shield is seen to be the same as in the typical *H. Herscheli*, but the coarse granulation on the apiculus is as described above in other specimens of this new variety *rectisuturalis*. The broader, more equilateral, and shorter rostral shield is another distinction from the type form of the species.

There is a complete, but probably young individual in the Stellenbosch Museum (C 1 Stell. Mus.) from an unknown locality, which, though for the most part in the condition of an internal cast, yet has

portions of the shell attached to the cheeks, the pleurae, and the pygidium, and this shows a close, nearly uniform granulation, unlike that in the typical *H. Herscheli*, the larger granules being scarcely differentiated. The head-shield and glabella show, however, characters which are indistinguishable from other examples of *H. Herscheli* var. *rectisuturalis*. The thorax, moreover, is interesting owing to the great width of the axis, which, at its front end, is one and a half times the basal width of the glabella, while the pleural lobes are less than half the width of the axis at its anterior end. There seems to be a complete absence of tubercles or spine-bases on the thorax and pygidium, but on the head-shield the pleuro-occipital ring near the genal angles is swollen and bears two large, stout spine-bases. The pygidium has the usual shape of *H. Herscheli*, being acutely triangular with strongly arched-down lateral lobes, which show pleurae to the number of 10-12 on their whole surface, though the posterior ones are weaker; the axis has more than 12 rings, but the posterior part is abraded; the doublure is precisely like that of *H. Herscheli*.

Dimensions :—

Length of head-shield	.	.	.	+17 mm.
Width of „	.	.	.	40 „
Length of glabella	.	.	.	15 „
Width of „ at base	.	.	.	17 „
„ „ „ at front	.	.	.	14 „
Length of thorax	.	.	.	43 „
Width of thoracic axis at front	.	.	.	25 „
„ „ „ at posterior end	.	.	.	14 „
Length of pygidium	.	.	.	+22 „
Width of „	.	.	.	20 „
„ „ axis at front	.	.	.	14 „

The poor specimen of a head-shield (29 S.A. Mus.) from Ezelfontein which Lake (*op. cit.*) referred to *H. Herscheli*, was thought by Schwarz * to belong to another species, but probably it is referable to the above-described variety.

Homalonotus (*Burmeisteria*) *Herscheli*, Murchison, var. *colossus*, Lake.

1904. *Homalonotus colossus* Lake, Ann. S. Afr. Mus., vol. iv, pt. 4, p. 216, pl. xxviii, figs. 1-3 (364 S.A. Mus.).

Clarke † was of the opinion that no specific characters existed in

* Schwarz, Rec. Alb. Mus., vol. i, pt. 6, 1906, p. 384.

† Clarke, *op. cit.*, 1913, p. 95.

this species of Lake's by which it could be distinguished from *H. Herscheli*, apart from its great size. But it seems that it may be worthy of being regarded as a variety, for there are more numerous (5) tubercles or spine-bases on the pleuro-occipital ring, and the thoracic segments bear 2 pairs of lateral spines or tubercles. An examination of Lake's type yields no further details than Lake described, but in the collection of the Cape University there are portions of 2 head-shields in a good state of preservation (309, 310) from Bokke Rivier, seventeen miles from Touws River, on the road to Ceres, which may be referred to the same form. The pleuro-occipital ring bears 4 or 5 spine-bases of subequal size, those in No. 309 forming 2 pairs, of which the outer pair is the larger; the minute ornamentation of the head-shield is precisely the same as in *H. Herscheli*, but the larger granules become more numerous and more closely placed on the rounded border, and the course of the transverse suture in front of the pre-glabellar area seems to be a simple broad curve, as in the variety *rectisuturalis*. The shape and lobation of the glabella (with the exception that the front end is more abruptly truncated), the paraglabellar areas, the eyes and the cheeks seem to be identical with *H. Herscheli*. The specimens indicate a head-shield 80-85 mm. in length and 150-160 mm. in width.

There is a large pygidium (317 Cape Univ.), also from Bokke Rivier, in the collection of the Cape University, preserved in a nodule and complete except for the tip, which is broken off, and for the lateral edges, which are hidden by the matrix. From its unusual size and occurrence at the same locality as the above-mentioned head-shields in this collection, it may probably be associated with the variety *colossus*, though it may only represent a specially large individual of the type form.

The first 9 rings of the axis of this specimen are well preserved, and are interesting because they show the diverse and unsymmetrical arrangement of the tubercles and spine-bases. The first 3 axial rings, and the 5th to the 8th inclusive, bear a large lateral spine-base on the left side, with a smaller one outside it on the first 3, but only the smaller one on the 4th ring. On the right side of the axis there is a corresponding large lateral spine-base on the first 5 rings and on the 7th, but not on the 6th, 8th, or 9th, and the smaller outer tubercle is only present on the first 3. There is a median pair of closely-placed spine-bases or large tubercles on the 2nd and 4th rings, but on the 6th, 8th, and 9th only the left-hand one is present, and it is smaller. The 1st ring has no

distinct median tubercle, but there is a rather unsymmetrical pair of widely-separated smaller tubercles. The posterior 7-8 rings on the axis seem devoid of tubercles or spine-bases, and successively become weaker, and the axial furrows which are distinct, though shallow, alongside the anterior 9 rings are almost obsolete alongside these last 7-8, and probably disappear completely before the tip is reached, but this part is missing. The first 4 pleurae bear a small tubercle or spine-base close to the axial furrows on the left side, and there is one large spine-base (and a smaller one inside it) further out on the 2nd pleurae. On the 3rd and 4th pleurae a small tubercle is situated near the axial furrow, but there is none on the 5th; the 6th, however, has a larger one further out. The remaining pleurae on the left side seem devoid of tubercles, and successively become weaker, the posterior ones being indistinguishable, as is well seen on the right side of the pygidium near its tip, where there are no traces of pleurae on the lateral lobes. The pleurae on the right side are mostly hidden, but on the 6th pleura there is a small tubercle near the axial furrow, and on the 7th a similar one with a larger one situated a little further out. The axis tapers rapidly at about 1 in 2 in the anterior part, but rather more slowly behind the 9th segment. The first 10 pleurae correspond precisely with the axial rings, and are gently convex, of uniform width and separated by narrow grooves. The whole surface of the pygidium is covered with small, round, sharp, isolated, large granules, rather widely separated, and of equal or subequal size, with a minute general granulation between them, as in the typical *H. Herscheli*.

The length of this broken pygidium is +70 mm., and the width of the axis at its front end 42 mm., but the whole pygidium must have measured over 80 mm. in length when perfect, and the total number of rings on the axis must have amounted to at least 20, while at least 12 pleurae are distinctly developed on the flanks, the posterior fourth or fifth part of the pleural lobes being smooth and devoid of segmentation.

Homalonotus (Burmeisteria) Herscheli Murch. var. nov. *fusiformis*.

1904. *Homalonotus Herscheli* Lake (pars), Ann. S. Afr. Mus., vol. iv, pt. 4, p. 214, pl. xxvi, figs. 2a, 2b (21 S.A. Mus.).

The much elongated, convex, semifusiform, pointed pygidium from Gamka Poort, which Lake figured and attributed to *H. Herscheli*, does not agree with the type, and must certainly be separated from this

species. It is, however, to this specimen rather than to Salter's figured types in the British Museum that part of Lake's description of the pygidial characters applies. For he states that "the tail forms a long triangle, is extremely convex, and ends in a sharp point; it is in fact half of a cone." The pleural lobes are slightly arched inwards underneath, and the terminal point is very acute and produced into a rounded mucro. The axial furrows are practically obsolete, and the axis is very broad and scarcely rises above the general convexity of the surface; it shows 13-14 complete rings before fading away into the non-segmented posterior portion of the pygidium. The pleural lobes curve down very steeply on each side, bending in slightly underneath, and only show traces of 5-7 broad, flat pleurae on the anterior part, while their posterior parts are smooth, the pleurae being obsolete. The pygidial segments are devoid of tubercles, except a small median one on the 3rd axial ring; but on the thoracic segments, which have a similar broad axis and strongly arched down pleurae, there seems to be a lateral tubercle on each side of the axial rings. A similar type of pygidium occurs in the British Museum (45080), and there are examples also in the Albany Museum.

The sharply-pointed pygidium of the Hunsrückian species from Belgium which has been recently described by Asselberghs as *H. Mallieuxi*,* possesses a similar mucro to our Bokkeveld form, but has a more defined and narrower axis.

Homalonotus (Burmeisteria) Herscheli Murch. var. nov. *Grahami*.

1906. *Homalonotus Herscheli* var. Schwarz, Rec. Albany Mus., vol. i, pt. 6, p. 38, pl. viii, fig. 8 (2554 Alb. Mus.).

Head-shield narrow, triangular, more or less pointed in front, the lateral margins converging anteriorly at an acute angle and the cheeks strongly bent down. Genal angles broadly rounded. Glabella oblong, very slightly urceolate, truncated abruptly at front end, with 3 pairs of lateral furrows all sloping obliquely backwards and more or less distinct; the basal lobes do not project at the sides. Paraglabellar areas subcircular, well-defined, deeply cutting into sides of basal lobes. Meso-occipital furrow strongly arched forward and angulated in middle. Meso-occipital ring simple. Pleuro-occipital ring with 1 or 2 strong tubercles or spine-bases near genal angles. Facial sutures with anterior branches nearly straight, con-

* Asselberghs, Bull. Soc. Belge Geol., etc., vol. xxxiii, 1923, p. 29, pl. i, figs. 7-9.

vergent, connected by straight (or very slightly angulated) transverse suture; posterior branches cutting genal angles behind widest curve. Rostral shield narrow, triangular, very sharply pointed behind, with weak, median, longitudinal ridge running back from low apiculus. Eyes small, elevated, situated opposite 2nd lateral lobes, and distant from glabella about half its width. Ornamentation of surface composed of large scattered sharp granules, with minute granulation between.

Remarks.—Schwarz figured a good example (2554 Alb. Mus.) of this form from Ezelfontein, which he rightly thought was separable from the typical *H. Herscheli*. The glabella is more oblong in shape and relatively longer; the whole head-shield is narrower, more arched down at the sides, and more pointed in front; the meso-occipital furrow is more sharply bent forward in the middle; the paraglabellar areas invade the basal lobes more deeply, and the minute ornamentation is slightly different, the tubercles being more numerous and closer together; the transverse suture is typically straight and not angulated. A specimen (7188 S.A. Mus.) of a similar head-shield from Wolfaardt's Farm, Ceres, may be referable to this variety.

Homalonotus (Burmeisteria) Herscheli Murch. var. nov. *bituberculata*.

(Pl. X, fig. 2.)

Head-shield subparabolic, bluntly-pointed anteriorly, with the sides converging at about 60° , but becoming more semicircular with age, gently convex from side to side, with the free cheeks descending more steeply. Glabella suboblong, widest at base, slightly constricted at half its length, and subcylindrical in front, the axial furrows at first converging and then running forwards subparallel to the rather abruptly truncated anterior end of glabella; lateral furrows more or less distinct; the anterior pair oblique, short, directed backwards, situated at about one-fifth the length of glabella; the second pair short, oblique, situated at half length of glabella in front of eyes at constriction of glabella; basal pair oblique, curved, long, situated at one-third length of glabella from base, incompletely marking off large basal lobes. Paraglabellar areas very faint, not invading basal lobes. Meso-occipital furrow strong, slightly arched forward in middle and at sides. Meso-occipital ring broad, rounded, with a large lateral spine-base on each side near axial furrows. Cheeks bearing prominent rounded boss, carrying small elevated eyes at about

half length of glabella, and distant about half its width from axial furrows. Genal angles rather abruptly rounded. Pleuro-occipital furrow very shallow, broad, and faint; pleuro-occipital ring swollen towards genal angle and bearing 2-3 spine-bases. Marginal furrow obsolete. Pre-glabellar area broad, flattened, slightly bent up. Apiculus short, triangular, bent down. Facial sutures with anterior branches subparallel, bending abruptly in at anterior ends to unite in a straight transverse suture. Surface finely granulated, with a few scattered larger granules.

Dimensions :—

	(I 254 Brit. Mus.)	(B 4 S.A. Mus.)
Length of head-shield . . .	41.5 mm.	34.0 mm.
Width of " " . . .	c. 68.0 "	c. 56.0 "
Length of glabella . . .	30.0 "	23.5 "
Width " " at base . . .	30.5 "	23.0 "
" " " at front . . .	20.5 "	16.0 "

Remarks.—This type of head-shield, of which the best specimen (I 254 Brit. Mus.) is from an unknown locality, somewhat resembles the variety *sodalis* described below, but the course of the axial furrows gives the glabella a distinctive shape, much like *H. quernus*, and the glabella is also relatively longer. The pair of lateral tubercles on the meso-occipital ring is also characteristic, though they may disappear with age, and the minute ornamentation is closely like that of *H. Herscheli*, and not like that of the variety *rectisuturalis*. The fact that the paraglabellar areas do not excavate the sides of the basal lobes increases the basal expansion of the glabella. Associated with the head-shield (B 4 S.A. Mus.) from Hoenderfontein are some pygidia in the same state of preservation, and of proportionate size to match the above-described head-shield. The best-preserved specimen is acutely triangular, ending behind in a short, sharp, subcylindrical mucro, and is very strongly convex from side to side, the pleural lobes descending with increasing steepness posteriorly and slightly compressed or hollowed out towards the end. The axis is distinctly but weakly defined, without any marked independent convexity, and it is composed of 16-17 complete rings and a short, terminal, non-annulated portion forming the blunt tip which ends some distance from the tip of the pygidium, the postaxial portion descending rather

suddenly to the mucro. The shape of the axis is conical, but it tapers more rapidly for the first 8-9 rings than it does posteriorly, as in *H. agrestis* Schwarz. On the first 6-7 rings there is a large, lateral spine-base on each side. The pleural lobes, which are very steep, only show 6-7 faint, low pleurae, some of which carry one or more tubercles; all the pleurae die out before reaching the lateral edges of the pygidium, which are sharp; the posterior third of the pleural lobes seems to be smooth, and the pleurae here are nearly or quite obsolete. On the anterior edge of each of the pleural lobes there is a large, triangular, inclined, articulating surface, rapidly widening to the lateral angle, and bearing a sharp diagonal furrow.

This type of pygidium is much like *H. Herscheli* var. *fusiformis*, but the axis and pleurae in the present form carry spine-bases, and the whole shape is less acutely pointed and tapering more slowly to the tip, so that it resembles in outline and obsolescence of pleurae *H. Clarkei* Kozl.,* from which it seems only distinguishable by possessing spine-bases.

Dimensions of pygidium (B 4 S.A. Mus.) :—

Length	.	.	.	.	31 mm.
Width	.	.	.	.	24 „

Homalonotus (*Burmeisteria*) *Herscheli*, Murchison, var. *perarmata*, Frech.

1856. *Homalonotus Herscheli*, Salter (pars), Trans. Geol. Soc., ser. 2, vol. vii, pl. xxiv, fig. 4 (11279 Brit. Mus.).

1897-1902. *Homalonotus perarmatus* Frech, Lethaea Geognostica, vol. i, Palaeoz., Bd. 2, p. 218, text-fig.

1906. *Homalonotus agrestis* Schwarz, Rec. Albany Mus., vol. i, pt. 6, p. 386, pl. ix, figs. 2a, b (1457 Alb. Mus.).

? 1906. *Homalonotus horridus* Schwarz, *ibid.*, p. 385, pl. ix, figs. 1a-c (1444 Alb. Mus.).

Frech founded his species *H. perarmatus* on a complete specimen, from "Saron, Cape Colony," but gave no description of it. Lake (*op. cit.*, 1904, p. 214) regarded it as only a variety of *H. Herscheli*, and Schwarz (*op. cit.*, p. 384) thought his *H. horridus* might be identical with Frech's species. With the latter view I rather hesitate to agree,

* Kozłowski, *op. cit.*, 1923, p. 24, pl. i, figs. 14, 15.

because of the shape of the pygidium and of the pygidial axis in *H. perarmatus*, which agrees in this respect with *H. agrestis* Schwarz, but not with *H. horridus* Schwarz. For the pygidium has a broadly triangular shape, with its lateral margins slightly excavated, so that it tapers at first rather rapidly, and then at about half its length more slowly to its tip, which is somewhat produced behind. The axis similarly tapers in its anterior half more rapidly than it does in its posterior portion. The doublure is broad at the tip but narrow at the sides. The minute ornamentation is that of the typical *H. Herscheli*.

In the South African Museum there is an excellent specimen (7194 S.A. Mus.) from the Cold Bokkeveld, of a nearly complete thorax, possessing 10 segments, and part of an eleventh one in front, attached to a pygidium, of which only the tip is missing. The thorax has a very wide axis, more than twice the width of the pleural lobes at its front end; the axis is somewhat flattened in the middle between the lateral tubercles, but outside them is arched down rather steeply to the axial furrows, which are distinct but shallow; the pleural lobes are bent down almost vertically on each side. The tubercles are rather irregularly disposed, but there is a lateral line of large tubercles down each side of the axis, though the right one on the 3rd ring is absent, and the left tubercles on the 2nd, 3rd, and 7th are smaller than those on right side. There is a median tubercle on the 4th, 6th, 7th, 9th, 10th rings, and a small pair on the 8th one. The 1st and 2nd pleurae have no tubercles; the 3rd and 4th have one large one on the fulcrum; the 5th has a smaller inner one as well; the 6th, 7th, and 9th have 3 tubercles, of which the two outer ones are much larger, but all are within the fulcrum; the 8th has only two large ones, and the 10th two small ones. The pygidium has large lateral tubercles on the first 5 axial rings, but the right tubercle on the 1st ring is missing, and so is the 4th one on the left side. The pleural lobes have a tubercle at half their length only on the 2nd pleura on the right side, but on the left side on the 3rd, and another on the 4th, and there are some much smaller ones on some of the posterior, narrow, faintly-marked, axial rings, and on the indistinct posterior pleurae. The pleurae do not correspond with the axial rings, and this is particularly apparent in the first 3-4 segments; all the pleurae die out shortly before reaching the margin, which is slightly arched inwards to the sharp edge on which it joins the abruptly incurved narrow doublure, which, however, widens behind at the elongated tip of the pygidium. There is another nearly complete thorax (with 10 segments preserved)

attached to a pygidium in the Stellenbosch Museum (E 416) from Osplaats in the Hex River Valley, which shows essentially the same characters, but has a more complete agreement in its tuberculation with Frech's figure.

In the South African Museum there is a complete individual (7192 S.A. Mus.) from Whupperthal, Clanwilliam, which seems identical, as far as the thorax and pygidium are concerned, with *H. perarmatus*, in all respects closely resembling Frech's figure. The head-shield has the front margin broken, but otherwise is nearly perfect. The glabella is scarcely urceolate, being of a suboblong shape; the anterior end is rather abruptly truncated, with a slight median emargination; the lateral angles of the frontal lobe are rounded, and it does not clearly project on each side. The lateral furrows are distinct, but the anterior ones which are situated at less than one-third the length of the glabella are weakest; the second pair is strong, horizontal, and at half the length of the glabella, while the basal ones are oblique, long, and demarcate triangular basal lobes, each occupying more than one-third the basal width of the glabella. The meso-occipital furrow is gently arched forward in the middle, and the paraglabellar areas slightly excavate the sides of the basal lobes. The meso-occipital ring is too much broken to show if it possessed any tubercles, but there is a swelling on the pleuro-occipital ring at about half its length carrying one or two spines. The fixed cheeks are narrow, being only about one-third the width of the glabella at the eyes, which are situated opposite the 2nd lateral furrows of the glabella; there is a weak, circumocular furrow on the swollen cheek. The free cheeks are rather steeply bent down; the lateral margins are nearly straight; the genal angles are rather sharply rounded and somewhat produced backwards. The facial sutures in front of the eyes slightly converge; but behind the eyes their posterior branches run obliquely back to cut the lateral margin just in front of the genal angles. The whole surface of the head-shield is rather coarsely, but closely and uniformly granulated.

The thorax and pygidium are almost identical with the specimen above described (7194 S.A. Mus.), except in the distribution of the tubercles and spine-bases. Thus there is a lateral spine-base, or large tubercle, on the left side of the 1st, 2nd, 5th, and 6th axial rings of the thorax, but on the right side there is one on the 1st (?) and 3rd, and then again on the 6th, 7th, 11th, and 13th, while the 3rd, 4th, 5th, and 9th right pleurae possess one just outside the axial furrow, and then another further out on the 13th

only. But on the left side the pleurae are broken off, so we do not know their distribution. On the pygidium there is a lateral spine-base on the 1st, 2nd, and 3rd axial rings on the right side, and on the 4th and 9th on the left side; on the right pleural lobe there are no spine-bases or tubercles at all, but on the left lobe the 1st pleura has one at half its length, and the 4th pleura has two smaller ones respectively at one-fourth and three-fourths its length. The non-correspondence of the pleurae with the axial rings is noticeable, but the change in the rate of tapering of the axis is scarcely apparent, though the lateral emargination and concavity on the sides of the pleural lobes is nearly as marked as in the other specimen (7194 S.A. Mus.).

With regard to *H. horridus*, which Schwarz thought might be inseparable from *H. perarmatus*, but which Clarke * considered belonged to *H. Herscheli*, an examination of the original specimen in the Albany Museum leads me to conclude that Schwarz was right. But it does not seem possible to separate it satisfactorily from *H. agrestis*, for there is no essential or constant difference, even the rate of tapering of the axis and excavation of the margins of the pygidium showing variability.

The type specimen of Schwarz's species (1444 Alb. Mus.) came from Clanwilliam, as does the above described complete individual (7192 S.A. Mus.), and it consists of a pygidium with a few thoracic rings attached. Neither the figure nor the description which Schwarz gave are quite sufficient, and a few more details of its characters may therefore be given. Each axial ring of the thorax has a single lateral tubercle, or a pair of closely-set tubercles on one base, while each pleura has only one large tubercle set at about one-third its length. Thus the tuberculation of the thorax much resembles that of *H. perarmatus* Frech, as Schwarz remarks. The pygidium of *H. horridus* possesses 13 distinct rings on the axis with traces of 1 or 2 more behind, and the first 6 axial rings have a lateral tubercle on the right side forming a regular longitudinal series, but on the left side it is only the 1st and 3rd rings which bear a corresponding lateral tubercle; there is a median tubercle also on the 2nd, 3rd, 4th, 6th, 7th, 12th, and 13th rings. As Schwarz remarks, the pleurae do not quite correspond with the axial rings, and die out some little distance from the edge of the pygidium, while the 2nd, 3rd, and 6th pleurae on the right side have a pair of closely-set tubercles, but only the 4th pleura on the left side has a similar pair, the rest on this side being without tubercles, except the 1st one, which has a single tubercle at about two-thirds its length.

* Clarke, *op. cit.*, 1913, p. 96.

Dimensions :—

	(7194 S.A. Mus.)	(7192 S.A. Mus.)
Length of head-shield . . .	..	+37.0 mm.
Width of " . . .	..	70.0 "
Length of glabella . . .	..	26.5 "
Width " " at base . . .	..	26.5 "
" " " at front . . .	..	21.5 "
Length of thorax . . .	..	62.0 "
" " " (10 segments) . . .	58.0 mm.	..
Width of axis at front end . . .	44.0 "	37.0 "
Width of thorax . . .	c. 63.0 "	..
Length of pygidium . . .	c. 50.0 "	+45.0 "
Width " " at front . . .	c. 41.0 "	c. 38.0 "
" " axis at front . . .	26.0 "	23.5 "
Length of axis . . .	35.5 "	c. 36.0 "

The lack of bilateral symmetry and the general irregularity in the distribution of the tubercles and spine-bases on the thorax and pygidium is a noticeable feature in all the forms here regarded as varieties of *H. Herscheli*, and for this reason the tuberculation must be regarded as of small specific or varietal value. Individuals, otherwise identical, differ considerably in this respect.

Homalonotus (Burmeisteria) Herscheli Murch. var. nov. *sodalis*.

(Pl. X, fig. 5.)

Cf. 1913. *Homalonotus Herscheli* Clarke, "Foss. devon. Parana," pl. iii; fig. 1, ? 2.

Head-shield transversely subparabolic, about twice as broad as long, gently convex from side to side, but not much bent down laterally. Glabella very slightly elevated, suboblong, as wide as long, narrowing a little anteriorly, the sides at first converging and then parallel, slightly concave; front end straight, abruptly truncated at right angles to axial furrows; lateral furrows nearly obsolete, the first pair nearly straight, obliquely directed backwards, situated at about one-fourth the length of the glabella, the second pair straight, nearly horizontal, situated at about half the length of the glabella, the basal pair longer, oblique, faintly marking off large, triangular, basal lobes. Paraglabellar areas large, nearly obsolete, not excavating sides of basal lobes. Cheeks with inner portion forming swollen boss

on which eyes are situated, at about level of second lateral furrows, and at less than half width of glabella from axial furrows; circum-basal furrow round eyes weak. Facial sutures with anterior branches rather rapidly convergent, nearly straight to front edge, then bending in sharply to unite as simple, nearly straight, transverse suture; posterior branches bending out behind eyes nearly at right angles in weak, sigmoidal curve, to cut lateral margin of genal angles in front of base of head-shield. Meso-occipital ring simple, smooth, without tubercles, extending outwards on each side to below eyes beyond base of glabella, the ends being marked by notches in posterior edge of head-shield; meso-occipital furrow strong, slightly arched forward in middle. Pleuro-occipital portion rounded, becoming swollen and wider laterally, and bearing group of 3 small spine-bases (of which the middle one is the largest) at about half its length; pleuro-occipital furrow weak, broad, dying out laterally. Genal angles broadly rounded. Marginal furrow quite obsolete. Preglabellar area flattened. nearly horizontal, large.

Dimensions (7199 S.A. Mus.):—

Length of head-shield	.	.	.	.	52.0 mm.
Width „ „	.	.	.	.	c. 106.0 „
Length of glabella	.	.	.	.	37.5 „
Width „ „ at front	.	.	.	.	28.0 „
„ „ „ at base	.	.	.	.	35.5 „
Distance between eyes	.	.	.	.	53.0 „
„ „ notches at sides of meso-occipital ring	.	.	.	.	48.5 „

Remarks.—There is one well-preserved head-shield in the South African Museum (7199 S.A. Mus.) on which this variety is based. It differs from *H. Herscheli* var. *rectisuturalis* by the different shape of the glabella, which is more truncate, and that there is no lateral overhang of the frontal lobe; the head-shield is also subparabolic, and the course of the facial sutures is slightly different. The new form *H. noticus* var. *africana* (described below) differs in the shape of the glabella and position of the lateral furrows on it as well as by the swelling of the lateral angles of the preglabellar area. Our specimen figured here is a good cast of the head, with the left side and whole middle-shield perfect; no rostral apiculus is seen, but probably a short one was present. The surface ornamentation is unknown. It is possible that this variety should be separated off as a distinct species.

Homalonotus (Burmeisteria) quernus Lake.

(Pl. X, fig. 1; Pl. IX, fig. 13 ?.)

1904. *Homalonotus quernus* Lake, Ann. S. Afr. Mus., vol. iv, pt. 4, No. 9, p. 216, pl. xxvii, fig. 1 (22 S.A. Mus.).

? 1904. *Homalonotus* sp. Lake, *ibid.*, p. 217, pl. xxvii, fig. 2 (23 S.A. Mus.).

1913. *Homalonotus quernus*, Clarke, "Foss. devon. Parana," p. 95.

This species was founded by Lake on an imperfect head-shield from an unknown locality, having a peculiar coarsely-tuberculated glabella, but the figure of the specimen did not show the three pairs of lateral furrows which are distinct on the left side, the lobation being quite clearly developed, nor was the anterior narrowing of the glabella indicated; it should also be pointed out that there is a group of specially-large tubercles on each basal lobe, and a large prominent tubercle or spine-base on each side of the meso-occipital ring, situated close to the axial furrows. Several thoracic segments were associated with this head-shield, but somewhat out of their natural position. The length of the glabella in the type specimen (22 S.A. Mus.) is about 50 mm., and its basal width about 55 mm.; so that it has a very short quadrate shape.

There is a well-preserved head-shield (In. 24101) in the British Museum, labelled simply "Cape of Good Hope," and named *H. Herscheli*, which is clearly identical with Lake's *H. quernus*, and it allows us to give a fuller definition of the species than Lake was able to do. This specimen shows that the head-shield has a transverse subparabolic rather than subtriangular shape, and is about twice as wide as long. The glabella is trapezoidal and not urceolate in shape, the sides converging anteriorly to about half its length, and then becoming subparallel to the abruptly-truncated, nearly-straight, anterior end. The lateral lobes are distinguishable, but the lateral furrows are very faintly impressed. Well-defined subcircular paraglabellar areas are present, but scarcely invade the basal lobes. The cheeks are much swollen, the inner part forming a prominent rounded boss which bears the eye, but the outer part is somewhat flattened and strongly arched down. The preglabellar area is flattened and smooth, but its front edge is broken. There are 5-6 tubercles on the meso-occipital ring, and the pleuro-occipital portion widens laterally to an obliquely-truncated outer end, swelling up near the genal angle into a large spine-base or tubercle. The occipital furrow is

strong, but the marginal furrow rather weak. The tuberculation of the glabella is much the same as in Lake's type specimen, the tubercles being few, of large but rather unequal size and irregularly distributed. The doublure is seen to be ornamented by short, minute, slit-like pits, elongated parallel to the edge and arranged in concentric lines, and the rostral shield is exposed below, though broken and imperfect, and bears a short, stout, subconical uncate apiculus. The fine ornamentation of the surface of the head-shield consists of a minute granulation with rather larger granules dotted about, as in *H. Herscheli*.

Dimensions :—

Length of head-shield	.	.	c. 38 mm.
Width „ „	.	.	c. 62 „
Length of glabella	.	.	26 „
Width of „ at base	.	.	28 „
„ „ „ at front	.	.	19 „
Distance between eyes	.	.	38 „

It is probable that the large pygidium from Ezelfontein (23 Cape Mus.) figured by Lake (*op. cit.*, pl. xxvii, fig. 2) as *Homalonotus* sp., should be attributed to *H. quernus*, for it possesses the large subequal, coarse, and numerous, but irregularly-distributed tubercles on its surface, like the head-shield on which the species is founded. We may observe that it possesses a similar outline and a similar change of rate in the tapering of the axis as *H. agrestis* Schwarz, and the latter species may be regarded as closely allied to Lake's *H. quernus*. Schwarz* has previously expressed the opinion that this pygidium is much like his *H. agrestis*, if not identical with it, but the spine-bases are much larger, coarser, and more numerous.

There is a portion of a thorax in the Kimberley Museum (3292 Kimb. Mus.) from Ceres, which has a very broad, flat axis, showing on each ring a large, single, lateral tubercle, or pair of tubercles (with sometimes a small accessory tubercle outside) on each side, and a row of 6-9 smaller subequidistant ones over the middle portion, so that the whole ring is tuberculated. The axial furrows are shallow, but there is a marked constriction separating off the pleural lobes from the axis, and the lobes are strongly bent down and much narrower than the axis. Each pleura bears a single large, or one large and one small, tubercle or spine-base, just at its base, and the whole surface of the thorax is covered with small closely set scabrosities or elongated granules.

* Schwarz, *op. cit.*, 1906, p. 387.

From the fact that the meso-occipital ring of *H. quernus* is the only species which bears a considerable number of tubercles or spine-bases, we may probably refer this thorax to this species on the strength of the numerous tubercles on the axial rings. Perhaps the few thoracic segments figured by Salter * from the Gydo Pass (11280 Brit. Mus.) as belonging to *H. Herscheli*, may, for the same reason, be placed here, though Schwarz † attributed them to his species *H. horridus*.

Dimensions (3292 Kimb. Mus.) :—

Length of the 8 segments of thorax	55 mm.
Width of thorax at front	c. 110 „
„ „ axis at front	c. 45 „

Homalonotus (*Burmeisteria* ?) *hippocampus*, Schwarz.

1906. *Homalonotus hippocampus* Schwarz, Rec. Albany Mus., vol. i, pt. 6, p. 388, pl. ix, figs. 5a, b (64 Alb. Mus.).
 1907. *Homalonotus hippocampus* Reed, Geol. Mag., Dec. v, vol. iv, p. 36.
 1913. *Homalonotus hippocampus* Clarke, "Foss. devon. Parana," p. 96.
 1918. *Homalonotus* (*Burmeisteria*) *hippocampus* Reed, Geol. Mag., Dec. vi, vol. v, pp. 315, 324.

This species was based by Schwarz on a nearly-perfect head-shield from an unknown locality, and the description is fairly complete. Clarke (*op. cit.*), however, thought that it might represent a young *H. Herscheli*, and was doubtful of its specific value. It is worthy of notice that a head-shield from Brazil, which was figured by Clarke ‡ as probably the young of his new species *H. Derbyi*, bears a considerable resemblance to *H. hippocampus*.

The median ridge along the glabella described by Schwarz in the type specimen is peculiar, but on examining the specimen it seems that it may be due to crushing, and not be an original feature. The shape of the glabella, the practical absence or obsolescence of the lateral furrows on its surface, the straight, transverse, connecting suture in front, the presence of a pair of spine-bases close to the genal angles, and other features suggest that it is only a young individual or narrow form of *H. Herscheli* var. *rectisuturalis*. In the Ordovician trilobite, *Ogygia Buchi* Brongn. we have a narrow and a wide form,

* Salter, *op. cit.*, 1856, pl. xxiv, fig. 5.

† Schwarz, *op. cit.*, 1906, p. 384.

‡ Clarke, "Trilob. Grez de Ezeré," Archiv Mus. Nac. Rio de Janeiro, vol. ix, 1890, p. 7, t. i, fig. 7.

the difference being regarded as sexual. Possibly the same explanation is applicable here.

Homalonotus (Burmeisteria) sp.

1856. *Homalonotus Herscheli* Salter (pars), Trans. Geol. Soc., ser. 2, vol. vii, pl. xxiv, fig. 3 (11278 Brit. Mus.), *non cet.*

An examination of the head-shield (11278 Brit. Mus.) from the Warm Bokkeveld, which Salter only indicated by a restored outline on his plate, and attributed to *H. Herscheli*, shows that it is better preserved than one would imagine, and that it is quite distinct from the typical *H. Herscheli*. Each of the basal lobes bears a spinose tubercle and there is also a submedian, more anteriorly-placed pair on the glabella, thus recalling their development in *H. subarmatus* Koch.* The urceolate shape of the glabella, lobation, and paraglabellar areas resemble *H. Herscheli*, but the minute ornamentation of the surface is coarser, and the granules are closer together and of equal size. Probably it is a distinct species, but we may hesitate to give such an imperfect specimen a new name. The regularity and distribution of the spine-bases on the glabella resemble to a great extent those in the members of the European subgenus *Burmeisterella* (e.g. *H. Champernounei* and *H. bifurcatus*†).

Homalonotus (Digonus) noticus, Clarke, var. nov. *africana*.

(Pl. X, fig. 4.)

- ? 1856. *Homalonotus Herscheli* Salter (pars), Trans. Geol. Soc., ser. 2, vol. vii, pl. xxiv, fig. 8 (11283 Brit. Mus.), *non cet.*

Head-shield short, broad, transversely semi-elliptical, with anterior margin slightly excavated; genal angles very broadly rounded; cheeks very slightly bent down. Glabella low, subconical, truncated abruptly in front, wider than long, broadest at base, narrowing anteriorly rather rapidly for about three-fourths its length, with lateral angles of frontal lobe somewhat swollen and slightly overhanging; lateral furrows very weak, nearly obsolete; anterior pair very short, situated at about one-fourth or one-fifth length of glabella from front end, slightly oblique; second pair horizontal and at about half length of glabella; basal pair gently curved back, obscurely marking off large basal lobes. Preglabellar area wide, flattened, somewhat bent up,

* Koch, Abh. k. preuss. geol. Landesanst., vol. iv, pt. 2, 1883, p. 18 [90], t. i, figs. 8, 9; Frech, Leth. Geogn., Palaeoz., vol. i, pt. 2, p. 218, text-fig.

† Reed, Geol. Mag., Dec. vi, vol. v, 1918, p. 325.

slightly depressed in centre with weakly excavated margin and swollen lateral angles. Cheeks strongly swollen, forming elevated bosses bearing small prominent eyes situated in front of second lateral furrows. and less than half width of glabella from its sides. Paraglabellar areas obsolete. Facial sutures with anterior branches short, strongly convergent to front edge, then bending in suddenly to unite in short, straight, transverse suture; posterior branches gently sigmoidal. Rostral apiculus very short, broad, triangular, projecting in front. Occipital segment simple, smooth, without spines or tubercles; occipital furrow strong. Marginal furrow obsolete. Surface of head-shield coarsely granulated.

Dimensions (247 Cape Univ.):—

Length of head-shield	. . .	19.0 mm.
Width „ „	. . .	29.0 „
Length of glabella	. . .	12.0 „
Width „ „ at base	. . .	14.0 „

Remarks.—There is only one good specimen (247 Cape Univ.) of this trilobite, and it consists of a nearly complete head-shield from Touws River Road. It may be regarded as a variety of *H. noticus* Clarke * from the Devonian of Brazil on account of its proportions, the truncate and emarginate anterior margin, the characters of the glabella, the course of the facial sutures, the well-rounded genal angles, and especially in the absence of tubercles and spine-bases. But our specimen has a coarsely-granulated instead of smooth surface. *H. Clarkei* Kozl.† also resembles it in the short glabella, swollen lateral angles of the preglabellar area, and coarse granulation. A distorted head-shield (438 Pret. Mus.) in the Pretoria Museum from Koudeveld Berg may perhaps be referred to our variety, and certain broad non-tuberculated pygidia, such as the one figured by Salter (*op. cit.*, fig. 8) (11283 Brit. Mus.), and one (3851 S.A. Mus.) in the South African Museum, may perhaps belong to it, as they much resemble *H. noticus*.

It is probable that this species and variety belong to the subgenus *Digonus* ‡ rather than to *Burmeisteria*, on account of the truncate or excavated anterior margin and absence of tubercles and spines.

Homalonotus (Digonus) fontinalis sp. nov.

(Pl. X, fig. 6.)

Head-shield subparabolic, with truncate anterior edge, excavated

* Clarke, *op. cit.*, 1913, p. 89, pls. i and ii.

† Kozlowski, *op. cit.*, 1923, p. 24, pl. i, figs. 12–15.

‡ Reed, *Geol. Mag.*, Dec. vi, vol. v, 1918, pp. 317, 324.

in the middle; posterior margin nearly straight. Glabella large, oblong, semicylindrical, of nearly uniform width, fully one-third the width of head-shield and five-sixths its length, with straight subparallel sides, and truncate anterior end; three pairs of short, oblique, subparallel lateral furrows present, nearly equidistant, the anterior pair at about one-third the length of glabella from front end. Occipital ring simple, rounded, with pleuro-occipital portions widening somewhat to genal angles; occipital furrow strong, narrow, of uniform depth, continuous, straight, with meso-occipital portion slightly arched forward in middle. Preglabellar border narrow, rounded, with anterior edge slightly excavated in middle between swollen, projecting, lateral angles. Fixed cheeks gently convex, somewhat swollen in middle; free cheeks strongly arched down. Genal angles bluntly pointed at about 75° ? Facial sutures with posterior branches arched back to cut margin at genal angles. Eyes small, elevated, situated opposite 2nd lateral furrows of glabella, and at about half its width from axial furrows. Surface of head-shield covered with rather coarse, widely-separated, rounded granules.

Thorax of 13 segments. Axis wide, gently convex, semicylindrical. Axial furrows distinct. Pleural lobes gently arched down at about two-thirds the width of axis; pleurae slightly convex, with strong oblique pleural furrow. Ornamentation same as head-shield.

Pygidium parabolic, strongly convex from side to side, and less so from back to front, nearly as wide as long. Axis convex, conical, bluntly pointed, not reaching posterior margin entirely circumscribed by furrows; completely annulated to tip with about 15 narrow, simple, coarsely-granulated rings. Postaxial piece simple, narrow, gently convex, transverse, coarsely granulated, connecting pleural lobes behind.

Pleural lobes composed of 14-15 sharply-raised, distinct, narrow pleurae reaching margin of pygidium, and each bearing a single row of large granules.

Dimensions :—

Length of whole trilobite . . .	c. 15.0 mm.
,, ,, head . . .	5.0 ,,
Width ,, ,, . . .	c. 9.5 ,,
Length ,, pygidium . . .	c. 4.0 ,,

Remarks.—There is only one small complete individual representing this interesting species, and it is perfect, except for the genal angles

and part of the thorax. It was collected by me at Ezelfontein, near Ceres, and is undoubtedly distinct from all the other Bokkeveld species of *Homalonotus*. The pygidium is rather like that of *H. vanuxemi* Hall.* The anterior excavated median edge of the head-shield and swollen lateral angles of the preglabellar area resemble *H. Clarkei* Kozl.,† but the glabella is much longer and narrower, and the whole head less transverse. *H. noticus* has a much larger preglabellar area and a smooth surface.

Homalonotus sp.

There is a well-preserved, large, rostral shield, of a species of *Homalonotus* (264a, b) from Keurbosch, Hex River district, in the collection of the University of Cape Town, the specific reference of which is doubtful. It is trapezoidal in shape, the two straight, or nearly straight narrowly rounded anterior edges meeting at an angle of about 110°; the longer posterior sides being inclined at an angle of about 75°, but the actual posterior angle is broken off. The general surface of the rostral shield is flat, but there is a slight concavity anteriorly on each side of a very short, low, broad, rounded median ridge, which is an almost imperceptible elevation, but rises up suddenly into the short, broad, low, rounded, subconical, blunt apiculus, which is submarginal and situated immediately behind the median anterior angle of the rostral shield. There are fine granules scattered over the whole flat surface, replaced by larger rounded granules or small tubercles on the rounded anterior edges and on the apiculus.

The absence of a median longitudinal ridge and the general flatness of the whole rostral shield are features which somewhat resemble that of *H. noticus*,‡ but our specimen is broader and the apiculus is more marginal.

Dimensions (264 a, b Cape Univ.): Length, c. 31 mm.; width (max.), 28 mm.

From the same locality and in the same matrix and condition there is also a well-preserved hypostome of a *Homalonotus* in the collection of the Cape University (297), which probably belongs to the same

* Hall, Palaeont. New York, vol. iii, 1859, p. 352, pl. lxxiii, figs. 9–11; *ibid.*, vol. vii, 1888, p. 11, pl. v B, figs. 1, 2; Williams and Breger, *op. cit.*, 1916, p. 286, pl. xxii, figs. 10, 12, 13, 15, 21.

† Kozłowski, *op. cit.*, 1923, p. 24, pl. i, figs. 12, 13.

‡ Clarke, *op. cit.*, 1913, p. 89, pl. ii, figs. 1, 8; R. and E. Richter, Centralbl. f. Miner., etc., Jahrg. 1917, No. 5, pp. 114–120, text-figs. 1–3.

species. It is subquadrate in form with a nearly straight anterior edge and flattened broad expanded alae, the shape of which is not quite clear, as their margins are broken. Behind the alae the lateral edges of the hypostome describe a gently-concave curve to the rounded posterior lateral angles, which project back slightly as rounded lobes. The posterior margin of the hypostome between them is emarginate, forming a broad, shallow, concave curve. The body is suboval and moderately convex, rounded anteriorly, but truncate behind. There is a pair of oblique, macular ridges at three-fourths its length from the front end, and there is an irregular group of 4-5 tubercles in the middle line at about one-fourth its length from the front end. The furrow marking off the body from the alae and from the flattened anterior border connecting the alae is shallow and weak, but on each side of the body and behind it the furrow limiting is better defined, but is broader behind than at the sides. The lateral borders are somewhat elevated, but the posterior edge is more swollen and rounded between the lobes, which are flattened. The granules, which are scattered over the surface, are not all of one size, and are irregularly and sparsely distributed. The general characters of this hypostome are like those of *H. Dekayi* (Green),* a species which Kozłowski † figures from the Devonian of Bolivia.

Dimensions : Length, 17 mm. ; width across alae, c. 28 mm. ; width at posterior end, 16 mm.

Acidaspis Atherstonei sp. nov.

(Pl. VII, figs. 7, 7a, b.)

Thorax flattened, composed of 11-12 segments, with horizontally extended pleural lobes. Axis broad, occupying more than the middle third of thorax, gently convex, cylindrical, densely and finely tuberculated. Pleurae straight, horizontal, of uniform width to base of free spine (?), each pleura composed of a narrow, rounded, anterior band, extending three-fourths its length, and of a broader, more elevated, and convex posterior band, swelling out rather suddenly into a rounded, subterminal enlargement before bending down as a free spine ; anterior band ornamented with a single row of a few large tubercles ; posterior band with 2-3 irregular rows of smaller tubercles clustered rather closely together at the subterminal swelling. Pygidium small, flattened, semicircular ; axis broad, short, conical, composed of 4-5

* Prosser and Kindle, Maryland Geol. Surv., 1913, Devonian, p. 328, pl. xliii, fig. 3.

† Kozłowski, *op. cit.*, 1923, p. 20, pl. i, figs. 1-10.

rings. Lateral lobes bearing 3 rounded, elevated, tuberculated, radiating pleurae on each side, widely separated by deep furrows. [? Margin of pygidium with corresponding free projecting spines.]

Dimensions :—

Length of thorax . . .	c. 35 mm.
Width „ „ at front . .	c. 30 „
„ „ axis at front . .	c. 11 „
Length of pygidium . .	c. 7 „
Width „ „ . .	c. 14 „

Remarks.—There are three specimens (In. 24103, 24104) in the British Museum, one of which (24103) consists of an impression and the natural cast (24103a), and the other of an impression only, all being portions of the thorax and pygidium of a species of *Acidaspis*, from Keurbooms River, Plettenberg Bay. The thorax is well preserved, but the ends of the pleurae are incompletely known, being broken off short or buried in matrix, and the pygidium is imperfect. But we may compare this species with *A. aracana* Steinmann,* from the Devonian of the Andes, and also with *A. tuberculata* Conr. var. *chacaltayana* Kozl.,† from Bolivia, with which the *Acidaspis* sp. figured by Salfeld‡ from the same country may be identical.

Acidaspis capensis sp. nov.

(Pl. XI, figs. 6, 7.)

Head-shield unknown. Thorax with broad, cylindrical axis very slowly tapering, about one-third the total width; pleural lobes horizontal and flattened for about half their width as far out as fulcrum, then sharply arched down as free pleural spines. Axial rings convex, rounded, with slight lateral swellings. Pleurae somewhat flattened, straight, and horizontal to fulcrum, divided by sub-median, straight, horizontal furrow parallel to pleural edges into a narrower anterior rounded band and a broader, more swollen posterior band; fulcrum rounded; extra-fulcral portion unfurrowed, bent down and backwards, and produced into free, sub-cylindrical, rounded spine. Surface of axis and pleurae coarsely tuberculated, the anterior

* Steinmann, Neues Jahrb. f. Miner. Geol., Beil. Bd. 34, 1912, p. 206, t. xi, figs. 1, 2.

† Kozłowski, *op. cit.*, 1923, p. 58, pl. v, figs. 13, 14.

‡ Salfeld, "Devon. Verstein. Bolivien" (App. I, Hauthal, Reisen in Bolivien), Wissensch. Veröff. Gesell. Leipzig, 1911, p. 208, t. i, fig. 5.

pleural band bearing a single row of large, contiguous tubercles. Pygidium (imperfectly known), very small, short, semicircular, of 2-4 segments; margin rounded, tuberculated; axis prominent, subcylindrical, of 3 or 4 rings; pleural lobes with 2-3 rounded pleural ridges. Surface coarsely tuberculated like thorax.

Dimensions (116a, b Cape Univ.):—

Length of thorax (11 segments)	15.5 mm.
Width to fulcrum	c. 14.0 „
„ of axis	6.0 „
Length of pygidium	3.5 „

Remarks.—There is only one impression (116a) and cast (116b) of the thorax and pygidium of this species, and the specimens which come from Stettyn, Worcester district, are in the collection of the University of Cape Town. Only a few of the anterior pleural spines are preserved, and the pygidium is imperfect, but its margin seems to be entire, though the marginal tubercles may have been spinose.

It is quite distinct from *A. Atherstonei* and its allies.

LIST OF FOSSILS FROM THE BOKKEVELD BEDS.

Zaphrentis ? *zebra* Schwarz.

„ ? sp.

Striatopora ? sp.

Placocystis africanus sp. nov.

Codaster aff. *pyramidatus* Shumard.

Ophiocrinus Stangeri Salter.

Crinoid stems.

Echinasterella ? sp.

Aspidosoma ? sp.

Fenestella sp.

Monotrypa ? sp.

Lingula Keideli Clarke.

„ *lepta* Clarke.

„ *scalprum* Clarke.

„ (*Glossina*) sp.

Orbiculoidea (Roemerella) cf. *collis* Clarke.

„ „ *Baini* (Sharpe).

„ ? *aberrans* sp. nov.

Orthis (Dalmanella) satelles sp. nov.

Stropheodonta Arcei Ulrich.

„ cf. *Katzeri* Knod.

Stropheodonta (Leptostrophia) concinna (Morris and Sharpe).

Schuchertella Sulivani (Morris and Sharpe).

„ ? *Baini* (Sharpe).

Chonetes falklandicus Morris and Sharpe.

„ *Rücki* Ulrich, var. nov. *medialis*.

„ *Stübeli* Ulrich.

„ cf. *Hallei* Clarke.

„ aff. *arcuata* Hall.

„ sp.

Spirifer antarcticus Morris and Sharpe.

„ „ var. nov. *gamkaensis*.

„ „ var. *kayseriana* Clarke.

„ *Ceres* Reed.

„ „ var. *Iheringi* Kayser.

„ *eulpeis* sp. nov.

Meristella cf. *Riskowski* Ulrich.

Cryptonella Baini (Sharpe).

Centronella cf. *Derbyana* (Hartt).

Leptocoelia flabellites (Conr.).

Coelospira ? *conjungens* sp. nov.

Vitulina pustulosa Hall ?

Ambocoelia pseudo-umbonata Kozłowski.

Rensselaeria montaguensis Reed.

„ *relicta* Schwarz.

„ *rotunda* Reed.

Trigleria ? *gydoensis* sp. nov.

Scaphiocoelia africana Reed.

„ „ var. *elizabethae* Reed.

Derbyina hottentot (Schwarz).

„ *simplex* (Schwarz).

„ *variiegata* (Reed).

„ *whitiorum* Clarke, var. nov. *africana*.

Rhynchonella (Clarkeia) Bodenbenderi (Kayser).

Retzia ? *Thomasi* sp. nov.

Nuculites abbreviatus (Sharpe).

„ *africanus* (Sharpe).

„ cf. *Benecke* Ulrich, var.

„ *capensis* Reed.

„ *obtusus* Reed.

„ *oblongatus* Conr.

„ *martialis* Reed.

- Nuculites pacatus* Reed.
 „ *Sharpei* Reed.
 „ „ var. nov. *remota*.
 „ (*Ditichia*) *colonicus* Reed.
Palaeoneilo antiqua (Sharpe).
 „ *arcuata* Schwarz.
 „ *rudis* (Sharpe).
 „ *Orbigny* Clarke.
 „ „ „ var. nov. *tenuilineata*.
 „ cf. *sancti-crucis* Clarke.
 „ *subantiqua* Reed.
 „ *vindicata* sp. nov.
Otenodonta Grahamsi Reed.
 „ *Stowi* sp. nov.
 „ ? *nigella* (Reed).
Nuculana inornata (Sharpe).
 „ *viator* Reed.
 „ ? *agrestis* Reed.
Modiomorpha hexensis sp. nov.
 „ *lunulata* (Schwarz).
 „ *montaguensis* sp. nov.
 „ *nigra* (Reed).
 „ cf. *austronotica* Clarke.
 „ cf. *scaphula* Clarke.
 „ (*Modiella* ?) sp.
Janeia Baini (Sharpe).
 „ *braziliensis* Clarke.
 „ *bokkeveldensis* (Reed).
 „ „ var. *acer* (Reed).
Grammysia (Grammysioidea) corrugata (Sharpe).
 „ „ *fontinalis* (Reed).
 „ „ *montana* Reed.
 „ „ *campestris* (Reed).
 „ „ *scaphuloides* sp. nov.
Goniophora gydoensis sp. nov.
 „ ? sp.
Sanguinolites albanus Reed.
Sphenotus ? cf. *Gorceixi* Clarke.
Sphenotomorpha Bodenbenderi (Clarke) var. nov. *capensis*.
Toechemya ? *rudis* (Sharpe).
Buchiola subpalmata Reed.

- Buchiola* sp.
Cardiola sp.
Praecardium bokkeveldense Reed.
Myalina brevicardinalis sp. nov.
Actinopteria Eschwegii Clarke.
Pterinopecten ? sp.
Hyalithes subaequalis (Salter).
 „ *D'Orbignyi* Kozłowski var. nov. *capensis*.
Conularia africana Sharpe.
 „ „ var. nov. *albertensis*.
 „ *Baini* Ulrich.
 „ *gamkaensis* sp. nov.
 „ *ulrichana* Clarke.
 „ *quichua* Steinm. and Dod.
Diaphorostoma Baini (Sharpe).
 „ ? sp.
Platyceras bokkeveldense sp. nov.
Loxonema capense Reed.
 „ *zwartbergense* sp. nov.
 „ cf. *gregaria* Knod.
Palaeoscurria Sharpei sp. nov.
Metoptoma capense Reed.
Pleurotomaria aff. *Kayseri* Ulrich.
Bellerophon (*Plectonotus*) *fraternus* Reed.
 „ „ cf. *Dereimsi* (Knod).
 „ „ cf. *laticarinatus* (Knod).
 „ „ *quadrilobatus* Salter.
 „ „ sp.
 „ (*Patellostium*) *africanoides* sp. nov.
 „ (*Tropidodiscus*) cf. *globosus* Knod.
 „ cf. *morganianus* Hartt and Rathbun.
Orthoceras bokkeveldense Reed.
 „ *gamkaense* Reed.
 „ (*Spyroceras* ?) *rex* Schwarz.
Tentaculites Baini Reed.
 „ *crotalinus* Salter.
 „ *desuetus* sp. nov.
Serpulites sica Salter.
Proetus malacus Lake.
 „ *hexensis* sp. nov.
Cyphaspis Dereimsi Kozłowski.

Dalmanites (Anchiopella) africanus Salter (sens. restr.).

- „ „ *cristagalli* (Woodw.).
 „ „ *arbutus* Lake (emend.).
 „ „ *Baini* sp. nov.
 „ (*Corycephalus* ?) *capensis* sp. nov.
 „ (*Hausmannia*) *Dunni* sp. nov.
 „ „ *lunatus* Lake.
 „ „ sp.
 „ (*Proboloides*) *ensifer* sp. nov.
 „ (*Acastella* ?) *pseudoconvexus* sp. nov.
 „ (*Cryphaeus*) *caffer* Salter (emend.).
 „ „ „ var. nov. *albana*.
 „ „ „ var.
 „ „ cf. *Pentlandi* Salter.
 „ „ cf. *australis* Clarke.
 „ „ ?, cf. *rostratus* Kozlowski.
 „ „ ?, *Ceres* Schwarz.

Phacops (Calmonia) ocellus Lake.

- „ „ *callitris* Schwarz.
 „ „ *impressus* Lake.
 „ „ „ var. nov. *vicina*.
 „ „ *Lakei* sp. nov.
 „ „ ?, *pupillus* Lake.
 „ (*Pennaia*) *Gydowi* Schwarz.
 „ „ *africanoides* (= *africana* Shand).
 „ (*Phacopina*) *hiemalis* sp. nov.
 „ (*Bouleia* ?) *Sharpei* sp. nov.

Typhloniscus Baini Salter.

Homalonotus (Burmeisteria) Herscheli (Murchison) (emend.).

- „ „ „ var. nov. *bituberculata*.
 „ „ „ var. *colossus* Lake.
 „ „ „ var. nov. *fusiformis*.
 „ „ „ var. nov. *Grahami*.
 „ „ „ var. *perarmata* Frech.
 „ „ „ var. nov. *rectisuturalis*.
 „ „ „ var. nov. *sodalis*.
 „ „ „ *quernus* Lake.
 „ „ „ *hippocampus* Schwarz.
 „ (*Digonus*) *noticus* Clarke var. nov. *africana*.
 „ „ „ *fontinalis* sp. nov.
 „ sp. ind.

Acidaspis Atherstonei sp. nov.

„ *capensis* sp. nov.

General Characters and Relations of the Fauna.

The author in 1907* gave a general account of the fauna of the Bokkeveld Beds and of its relations to those in the Devonian rocks of various parts of South America, and since then Clarke † has reviewed all the evidence in the light of further work. Kozłowski ‡ has also dealt with the subject still more recently. The general conclusion as to the close similarity of the fossils in these widely-separated areas has been maintained, but we have now additional evidence from South Africa to be brought forward in its support. The differences between this austral Devonian fauna and the corresponding boreal faunas of North America, and especially of Europe, are strongly marked. There can be but little doubt as to the age and correlation of the Bokkeveld Beds as a whole. The continental mass around which the southern Devonian shore-faunas flourished has been termed by Clarke § “Falklandia,” “the parent land-asylum out of which, in post-carboniferous time, Western Gondwana and Antarctica were carved.”

The following is a list of Bokkeveld fossils which occur in the corresponding beds in South America or on the Falkland Islands:—

Lingula Keideli.

„ *lepta.*

„ *scalprum.*

Orbiculoidea Baini.

Stropheodonta Arcei.

„ *concinna.*

Schuchertella Sulivani.

Chonetes falklandicus.

„ *Stübeli.*

Spirifer antarcticus (and vars.).

„ *Ceres.*

„ „ var. *Iheringi.*

Leptocoelia flabellites.

* Reed, Geol. Mag., Dec. v, vol. iv, 1907, pp. 165–171, 222–232.

† Clarke, “Foss. devon. Parana,” Mon. Serv. Geol. Miner. Brasil, vol. i, 1913, pp. 1–83, 326–351.

‡ Kozłowski, “Faune dev. Bolivie,” Ann. de Paléont., vol. xii, 1923, pp. 5–19 and 102–109.

§ Clarke, Proc. Nat. Acad. Sc. U.S.A., vol. v, 1919, p. 102.

- Cryptonella Baini*.
 ? *Vitulina pustulosa*.
Ambocoelia pseudo-umbonata.
Rhynchonella Bodenbenderi.
Nuculites capensis.
 „ *obtusus*.
 „ *oblongatus*.
 „ *pacatus*.
 „ *Sharpei*.
 ? *Palaeoneilo sancti-crucis*.
 „ *orbigny*.
Nuculana viator.
Janeia braziliensis.
 „ *bokkeveldensis*.
Actinopteria Eschwege.
Hyalithes subaequalis.
Conularia africana.
 „ *Baini*.
 „ *ulrichana*.
 „ *Quichua*.
Orthoceras bokkeveldense.
Tentaculites crotalinus.
Serpulites sica.
Cyphaspis Dereimsi.
Dalmanites (Anchiopella) africanus (=acacia).
 ? *Phacops (Calmonia) ocellus*.
Homalonotus (Burmeisteria) Herscheli.

Of those Bokkeveld fossils which may only be compared with South American species because of the impossibility of exact identification which is generally due to the poor preservation or imperfection of the available material, the following is a list :—

- Codaster* cf. *pyramidatus*.
Orbiculoidea cf. *collis*.
Stropheodonta cf. *Katzeri*.
Chonetes cf. *Hallei*.
Meristella cf. *Riskowski*.
Centronella cf. *derbyana*.
Modiomorpha cf. *scaphula*.
Nuculites cf. *Benecke*.
Sphenotus cf. *Gorceixi*.

- Loxonema* cf. *gregaria*.
Bellerophon cf. *Dereimsi*.
 „ cf. *laticarinatus*.
 „ (*Tropidodiscus*) cf. *globosus*.
 „ cf. *morganianus*.
Dalmanites (*Cryphaeus*) cf. *australis*.
 „ „ cf. *rostratus*.
 „ „ cf. *Pentlandi*.

The following Bokkeveld fossils may be recognised as constituting definite varieties of South American species :—

- Chonetes Rücki* Ulr. var. nov. *medialis*.
Derbyina whitiorum Clarke, var. nov. *africana*.
Sphenotomorpha Bodenbenderi Clarke var. nov. *capensis*.
Hyalolithes D'Orbignyi Kozl. var. nov. *capensis*.
Homalonotus noticus Clarke, var. nov. *africana*.

Of allied species in the South African and South American Devonian faunas we have the following :—

- | | | | | |
|----------------------------------|---|---|---|---|
| <i>Orthis satelles</i> | . | . | . | aff. <i>O. Pradoi</i> Kozl. |
| <i>Spirifer euelpis</i> | . | . | . | aff. <i>Spirifer plano-convexus</i> Knod. |
| <i>Rensselaeria montaguensis</i> | . | . | . | aff. <i>R. falklandica</i> Clarke. |
| <i>Scaphiocoelia africana</i> | . | . | . | aff. <i>Sc. boliviensis</i> Whitf. |
| <i>Derbyina variegata</i> | . | . | . | aff. <i>D. Smithi</i> (Derby). |
| <i>Nuculites obtusus</i> | . | . | . | aff. <i>N. Branneri</i> Clarke. |
| <i>Palaeoneilo antiqua</i> | | | | |
| „ <i>subantiqua</i> | | | | |
| „ <i>arcuata</i> | | | | |
| „ <i>vindicata</i> | . | . | . | aff. <i>P. elliptica</i> Kozl. |
| <i>Ctenodonta Grahami</i> | . | . | . | aff. <i>Ct. musculosa</i> Knod. |
| „ ² <i>nigella</i> | . | . | . | aff. <i>Nucula Kayseri</i> Clarke. |
| <i>Nuculana inornata</i> | . | . | . | aff. <i>N. viator</i> Reed (= <i>N. inornata</i> Clarke, non Sharpe). |
| „ <i>viator</i> | . | . | . | aff. <i>Leda</i> sp. a Ulrich. |
| <i>Modiomorpha hexensis</i> | . | . | . | aff. <i>M. pimentana</i> (pars) Clarke. |
| „ <i>lunulata</i> | . | . | . | aff. <i>M. Helmreicheni</i> Clarke. |
| „ <i>montaguensis</i> | . | . | . | aff. <i>M. pimentana</i> Clarke. |
| „ <i>nigra</i> | . | . | . | aff. <i>Goniophora?</i> <i>abbreviata</i> Clarke. |
| „ (<i>Modiella?</i>) sp. | . | . | . | aff. <i>Modiomorpha</i> sp. (Clarke). |
| <i>Janeia Baini</i> | . | . | . | aff. <i>J. braziliensis</i> Clarke. |

<i>Grammysia corrugata</i>	}	. . .	aff. <i>Modiomorpha</i> ? <i>scaphula</i>
„ <i>scaphuloides</i>	}		Clarke.
„ <i>fontinalis</i>	.	. . .	aff. { <i>Gr. Lundi</i> Clarke.
			{ <i>Gr. Gardneri</i> Clarke.
„ <i>montana</i>	.	. . .	aff. <i>Gr. Lundi</i> Clarke.
„ <i>campestris</i>	.	. . .	aff. <i>Gr. rara</i> Kozl.
<i>Sanguinolites albanus</i>	.	. . .	aff. <i>Leptodomus</i> sp. Kayser.
<i>Diaphorostoma Baini</i>	.	. . .	aff. { <i>D. furmanianum</i> H. and B.
			{ <i>D. allardycei</i> Clarke.
<i>Loxonema capense</i>	.	. . .	aff. <i>L. glabrum</i> Kozl.
„ <i>zwartbergense</i>	.	. . .	aff. <i>L.</i> aff. <i>attenuatum</i> Hall (<i>fide</i> Knod).
<i>Pleurotomaria</i> aff. <i>Kayseri</i>	.	. . .	aff. <i>Pl. Kayseri</i> Ulrich.
<i>Bellerophon</i> (<i>Plectonotus</i>) <i>fraternus</i>			aff. <i>B. Salteri</i> Clarke.
<i>Orthoceras bokkeveldense</i>	.	. . .	aff. { <i>O. Ulrichi</i> Kozl.
			{ <i>O. Steinmanni</i> Kozl.
„ <i>gamkaense</i>	.	. . .	aff. <i>O.</i> cf. <i>gamkaense</i> Reed (<i>fide</i> Clarke and Kozl.).
„ <i>rex</i>	.	. . .	aff. <i>O. san-bartolomense</i> Kozl.
<i>Tentaculites desuetus</i>	.	. . .	aff. <i>T. Stübeli</i> Clarke.
<i>Dalmanites</i> (<i>Anchiopella</i>) <i>Baini</i>	.	. . .	aff. <i>Ph. acacia</i> Schwarz.
„ (<i>Corycephalus</i>) <i>capensis</i>	aff.		{ <i>D. Drevermanni</i> Thomas.
			{ <i>D. Boehmi</i> Knod.
„ (<i>Hausmannia</i>) <i>Dunni</i>	aff.		{ <i>D. maecurua</i> Clarke.
			{ <i>D. Clarkei</i> Ulrich.
„ „ <i>lunatus</i>	aff.		<i>D. patacamayensis</i> Kozl.
„ (<i>Proboloides</i>) <i>ensifer</i>	.	. . .	aff. <i>D. paituna</i> Hartt and Rathb.
„ (<i>Cryphaeus</i>) <i>caffer</i>	.	. . .	aff. <i>Cr. australis</i> Clarke.
<i>Phacops</i> (<i>Calmonia</i>) <i>Lakei</i>	.	. . .	aff. <i>Ph. (Calm.) ocellus</i> Clarke (? Lake).
„ „ <i>callitris</i>	.	. . .	aff. <i>Ph. (Calm.) signifer</i> Clarke.
„ „ <i>impressus</i>	.	. . .	aff. <i>Ph. (Calm.) subseciva</i> Clarke.
„ (<i>Acastella</i> ?) <i>pseudoconvexus</i>	aff.		<i>Ph. (\" Ac.\" convexus</i> Ulr.
„ (<i>Pennaia</i>) <i>Gydowi</i>	.	. . .	aff. <i>Ph. (Penn.) pauliana</i> Clarke.
„ (<i>Phacopina</i>) <i>hiemalis</i>	.	. . .	aff. <i>Ph. (Phac.) devonica</i> Ulr.
„ (<i>Bouleia</i>) <i>Sharpei</i>	.	. . .	aff. <i>Ph. (Boul.) Dagincourti</i> Ulr.
<i>Acidaspis Atherstonei</i>	.	. . .	aff. <i>A. aracana</i> Steinm.

Clarke * is of the opinion that there is an “ evident closer affiliation in expression between the Falkland fauna with that of the Bokkeveld

* Clarke, *op. cit.*, 1913, pp. 329–332.

series than with the much nearer regions at the west," but the foregoing list hardly points that way, and the richness of the South African fauna more approaches that of the continent of South America.

As regards the stratigraphical succession and lithological characters of the beds, Clarke * has pointed out that just as in the Bokkeveld series there are shales with calcareous nodules near the base, so in the Falkland Islands and in the Ponta Grossa shales of Parana there are similar nodules, and he remarks that "their general distribution through the austral beds may indicate correlative sedimentary conditions." The general uniformity and absence of differentiation of the sedimentary and of the faunistic facies of the beds is a remarkable feature throughout the whole austral region, but local differences of minor importance are observable, and there are well-marked divisions into shales and sandstones in the South African succession. In Bolivia Kozłowski † has recognised several subdivisions of the Devonian, although the lithological composition of the whole series is fairly uniform, being likewise argillaceous or arenaceous shales, sandstones, and quartzites. This author correlates some of the South American Beds with the Middle or even Upper Devonian of North America, but he puts all the South African Bokkeveld Beds and the Devonian of the Falkland Isles with the Lower Devonian (Oriskany), and in South America he puts on the same general horizon the Icla Formation of Bolivia, the Parana, the Grès de Maccuru, and the Matto Grosso and Argentine beds.

Clarke (*op. cit.*, p. 7), after a wide study of the various collections from South America, the Falkland Islands, and South Africa, concludes that "the entire assemblage, inclusive of all the Devonian faunas thus far known from Brazil (with the exception of the sandstone fauna (Middle Devonian) and black shale fauna (Upper Devonian) of Eréré and vicinity) from all horizons in Bolivia, Argentina, the Falkland Islands, and Cape Colony (not including the Witteberg Beds), bears a special and distinctive impress which is characterised as austral in contrast to the boreal aspect of homotaxial faunas north of the equator. These distinctions consist in specific resemblances without identities; in parallel developments affording different resultants; in invasions of generic structures more or less clearly disturbing generic agreements, and in irregular outgrowth of species distinctions on generic foundations common both to the north and the south." He further states that the fauna is seen to be essentially a unit and biologically uniform, and that its intrinsic

* Clarke, *op. cit.*, 1913, pp. 328, 329.

† Kozłowski, *op. cit.*, 1923, pp. 7-19.

characters indicate that it represents only the Early Devonian stages, the later stages of the Devonian being wholly absent.

Clarke (*op. cit.*, 1913, pp. 21–27) has specially emphasised the fundamental stamp and generic and specific differentials of the members of the austral fauna, particularly in the case of the trilobites (phacopids) and lamellibranchs (taxodonts). In his special remarks on the Bokkeveld Beds in relation to those of other areas in the austral province (Clarke, *op. cit.*, pp. 57–61), he comments on the doubtful basis of many of the species, and of the poor preservation of many of the specimens which make not only their specific definitions but also their supposed affinities to be of an unsatisfactory nature and questionable value. To some extent the new Bokkeveld material which the author has described in the preceding pages removes this reproach, and enables us with much greater assurance to estimate the relationships of the members of the fauna and of its characters as a whole.

With regard to the stratigraphical or local distribution of the fossils in the Bokkeveld Beds, we have only a comparatively few cases in which a careful collection has been made from the same horizon or bed at different localities, but so far as this evidence goes it indicates that a zonal distribution of the fauna is probably present, certain species being specially abundant on, or restricted to, certain horizons. Much further collecting and work of this kind are required before we can say that definite stratigraphical horizons can be recognised in the Bokkeveld series by means of their fossil contents.

Thus Dr. S. H. Haughton has recently collected a number of fossils from the First Sandstone east of Klein Straat Siding, and they comprise the following species :—

Leptocoelia flabellites Conr.

Spirifer antarcticus Morr. and Sh.

„ „ var. *kayseriana* Clarke.

„ *Ceres* var. *Iheringi* Kayser.

Stropheodonta Arcei Ulr.

Derbyina whitiorum Clarke, var. *africana*.

Janeia brasiliensis Clarke.

Bellerophon (*Plectonotus*) sp.

Crinoid stems, etc.

The present author obtained the following fossils from the one small exposure of beds at a roadside cutting near Buffelskraal, north-east of De Doorns, in the Upper Hex River Valley; all of these species came from the same bed, a greenish, micaceous sandstone.

- Placocystis africanus* sp. nov.
Codaster aff. *pyramidatus* Shum.
Leptocoelia flabellites Conr.
Cryptonella Baini Morr. and Sh.
Derbyina whitiorum Clarke, var. *africana* ?
Retzia ? *Thomasi* sp. nov.
Stropheodonta Arcei Ulr.
Sphenotomomorpha Bodenbenderi Clarke, var.
Modiomorpha hexensis sp. nov.
Tentaculites desuetus sp. nov.
Cyphaspis Dereimsi Kozl.
Dalmanites (*Cryphaeus*) *caffer* Salt.
 ,, ,, cf. *rostratus* Kozl.
 ,, (*Anchiopella*) sp.
Phacops (*Calmonia*) *Lakei* sp. nov.
Homalonotus (*Burmeisteria*) *Herscheli* (Murch.) ?

In the collection of the Cape University there are many specimens from a locality termed "Touw's River Road, Upper Hex River Valley," which are preserved in precisely the same rock and condition as those collected by me near Buffelskraal in this valley, and the reverse of one of the specimens of *Phacops Lakei* (138 Cape Univ.) was found by me at this place, so that it is practically certain that the locality as well as the horizon is identical. The following species have been recognised in the collection made by Messrs. A. R. E. Walker and F. C. Partridge in the Cape University :—

- Chonetes Rücki* var. *medialis* (207 Cape Univ.).
Phacops (*Calm.*) *Lakei* (138, 232, 257, 147 Cape Univ.).
 ,, (*Phacopina*) *hiemalis* ? (243 Cape Univ.).
 ,, (*Bouleia* ?) *Sharpei* (198 Cape Univ.).
Dalmanites (*Anch.*) *Baini* (181a Cape Univ.).
 ,, (*Coryc.*) *capensis* (216 Cape Univ.).
 ,, (*Hausm.*) sp. (202 Cape Univ.).
 ,, (*Cryph.*) *caffer* (175, 179, 169 Cape Univ.).
Homalonotus (*Burm.*) *Herscheli* var. *rectisuturalis* (251, 229, 180 Cape Univ.).
 ,, *noticus* var. *africana* (247 Cape Univ.).

As regards other localities the following lists of fossils can be given from my examination of the collections in various museums, but it cannot be maintained that only one horizon is represented at each

locality or that the specimens have all been obtained from precisely the same spot, for the local names have been frequently used with a wide significance.

HOTTENTOT'S KLOOF, CERES.

- Striatopora* ? sp. (H 67 Stell. Mus.).
Lingula Keideli (120 S.A. Mus.).
 „ *scalprum* (H 67 Stell. Mus.).
 „ (*Glossina*) sp. (121 S.A. Mus.).
Stropheodonta Arcei (81f S.A. Mus.).
Derbyina hottentot (2578 Alb. Mus.).
Nuculites abbreviatus (3847 S.A. Mus.).
 „ *Sharpei* (3849 S.A. Mus.).
 „ *colonicus* (3839, 3856 S.A. Mus.).
 „ *capensis* (3827 S.A. Mus.).
Nuculana inornata (11340 Brit. Mus.) (3845, 3968, 3865 S.A. Mus.),
 (104 Alb. Mus.), (462 Pret. Mus.).
Palaeoneilo arcuata (3866 S.A. Mus., 2nd shale), (103 Alb. Mus.).
 „ *rudis* (11341, 14847, 52051 Brit. Mus.), (3878, 3844, 3837,
 800 S.A. Mus.), (83, 84, 85, 86 Alb. Mus.),
 (3844 S.A. Mus., 2nd shales).
 „ *subantiqua* (3835, 3866 S.A. Mus.).
Modiomorpha cf. *austronotica* (122 S.A. Mus.).
Tentaculites desuetus (H 79 Stell. Mus.).
Pleurotomaria aff. *Kayseri* (70f S.A. Mus.).
Orthoceras gamkaense (3880 S.A. Mus.).
Dalmanites (*Cr.*) *caffer* (11286 Brit. Mus.), (3850 S.A. Mus.), (419
 Pret. Mus.).
 „ (*Cr.*) cf. *australis* (3850 S.A. Mus.), (11286 Brit. Mus.).
 „ (*Anch.*) *africanus* (11297 Brit. Mus.).
Homalonotus Herscheli var. (3853 S.A. Mus.).

UITKOMST, CERES.

- Stropheodonta concinna* (466 Pret. Mus.).
Schuchertella Sulivani (2493 Alb. Mus.), (420 Pret. Mus.), (113, 365
 S.A. Mus.), (157 S.A. Mus.).
Chonetes falklandicus ? (82f S.A. Mus.).
Leptocoelia flabellites (2493 Alb. Mus.), (415, 402 Pret. Mus.), (129
 Kimb. Mus.), (1st Sand., 220 S.A. Mus.).
Spirifer antarcticus (215, 216, 217, 218, 219, 220 S.A. Mus.), (2601
 Alb. Mus.).

Spirifer antarcticus var. *kayseriana* (404, 405 Pret. Mus.), (2601 Alb. Mus.), (Sedgw. Mus.).

„ *Ceres* (139 S.A. Mus.).

„ „ var. *Iheringi* (S.A. Mus.).

Ambocoelia pseudo-umbonata (2493 Alb. Mus.), (130, 211 S.A. Mus.).

Spirifer euelpis (404 Pret. Mus.), (3820, 3821 S.A. Mus.).

Derbyina hottentot ? (129 Kimb. Mus.).

„ sp. (138 S.A. Mus.).

Vitulina pustulosa ? (220 S.A. Mus.).

Nuculana inornata (77f S.A. Mus.).

Palaeoneilo rudis (3822 S.A. Mus.).

? *Pterinopecten* sp. (82 S.A. Mus.).

Conularia sp. (138 S.A. Mus.).

Homalonotus Herscheli var. *colossus* (364 S.A. Mus.).

Proetus hexensis (3889 S.A. Mus.).

NEAR CERES VILLAGE, ALONG VALSCH RIVER.

Chonetes falklandicus (136 S.A. Mus.).

HAARTEBEESTE KRAAL, CERES.

Chonetes falklandicus (127 S.A. Mus.).

LAKEN VLEI, CERES.

Stropheodonta Arcei (408 Kimb. Mus.).

Schuchertella Sulivani (3371 S.A. Mus.).

Leptocoelia flabellites (3938, 3370, 3941 S.A. Mus.).

Cryptonella Baini (132, 134 S.A. Mus.), (459 Pret. Mus.).

Centronella cf. *derbyana* (132 S.A. Mus.).

Nuculites colonicus (3793 S.A. Mus.).

„ *Sharpei* (3788 S.A. Mus.).

Palaeoneilo Orbignyi (3791 S.A. Mus.).

Bellerophon cf. *laticarinatus* (3794, 3785 S.A. Mus.).

Tentaculites crotalinus (3794 S.A. Mus.), (132 S.A. Mus.).

Hyalithes subaequalis (3790 S.A. Mus.).

Dalm. (Cr.) caffer (3795 S.A. Mus.).

Homalonotus Herscheli var. *rectisuturalis* ? (3948 S.A. Mus.).

WOLVAART'S FARM, CERES.

Schuchertella Sulivani (212 S.A. Mus.).

Dalmanites (Anch.) Baini (26 S.A. Mus.).

„ (*Cr.*) *caffer* (34 S.A. Mus.).

Homalonotus Herscheli var. *Grahami* (203 S.A. Mus.).

VAN WYT'S FARM, CERES.

Nuculites Sharpei (68f S.A. Mus.).

HOTTENTOT'S KRAAL, CERES.

Orthis satellites (138a, 140a S.A. Mus.).

Chonetes sp. (3896, 3944, 3914 S.A. Mus.).

Stropheodonta cf. *Katzeri* (3903, 3904, 3923 S.A. Mus.).

„ *arcei* ? (3908 S.A. Mus.).

Coelospira conjungens (3895 S.A. Mus.).

Leptocoelia flabellites (3909 S.A. Mus.), (3804 S.A. Mus.), (3759 S.A. Mus.), (3923 S.A. Mus.), (3806 S.A. Mus.).

Spirifer antarcticus var. *kayseriana* (3806, 3804 S.A. Mus.).

Derbyina variegata (3889, 3875 S.A. Mus.), (400 Pret. Mus.).

„ *whitiorum* var. *africana* (3884, 3913, 3389 S.A. Mus.), (458 Pret. Mus.).

Cryptonella Baini (3928 S.A. Mus.).

Nuculites Sharpei (3929, 3835, 3832 S.A. Mus.).

Dalmanites (*Anchiop.*) *Baini* (3934 S.A. Mus.).

WITZENBERG VALLEY, CERES.

Chonetes Stübels (126 S.A. Mus.).

Spirifer antarcticus (2600, 257, 40 Alb. Mus.), (140 S.A. Mus.).

SLANGFONTEIN, CERES.

Spirifer ceres var. *Iheringi* (145 S.A. Mus.), (2597, 2598, 2599 Alb. Mus.).

Spiriferina euelpis ? (35 S.A. Mus.).

Ambocoelia pseudo-umbonata (130 S.A. Mus.).

BAVIAN'S KLOOF.

Centronella cf. *derbyana* (467 Pret. Mus.).

ZWAR MOED, CERES.

Lingula lepta (3763 S.A. Mus.).

Leptocoelia flabellites (3767 S.A. Mus.).

Nuculites Sharpei (3770 S.A. Mus.).

„ *oblongatus* (3777 S.A. Mus.).

Homalonotus Herschels var. (3951 S.A. Mus.).

TWO MILES N.E. OF CERES.

Stropheodonta cf. *Katzeri* (H 196 Stell. Mus.).

EZELFONTEIN, CERES.

- Orthis satellites* (414 Pret. Mus.).
Schuchertella Sulivani (406 Kimb. Mus.), (417 Pret. Mus.), (2596 Alb. Mus.).
Derbyina whitiorum var. *africana* (48 Cape Univ.).
 „ *variegata* (400 Pret. Mus.).
Leptocoelia flabellites (413 Pret. Mus.), (2596 Alb. Mus.).
Rhynchonella (Clarkeia) Bodenbenderi (Sedgw. Mus.).
Nuculites africanus (104 S.A. Mus.).
 „ *abbreviatus* (2574 Alb. Mus.).
 „ *oblongatus* (Sedgw. Mus.).
 „ *martialis* (103 S.A. Mus.).
 „ *pacatus*.
 „ *Sharpei* (18, 19 S.A. Mus.), (418 Pret. Mus.).
 „ *colonicus* (69 S.A. Mus.).
Nuculana viator (2576 Alb. Mus.).
Palaeoneilo subantiqua (85 S.A. Mus.), (158a S.A. Mus.), (2579 Alb. Mus.), (E 450, 451 Stell. Mus.).
 „ *Orbigny* (77 Cape Univ.).
 „ *sancti-crucis* (3965 S.A. Mus.), (105 S.A. Mus.).
Grammysia fontinalis (183a S.A. Mus.).
 „ *campestris* (102 S.A. Mus.).
 „ *scaphuloides* (214 S.A. Mus.) (72 Cape Univ.).
Sphenotomomorpha Bodenbenderi var. *capensis* (303 Cape Univ.).
Conularia ulrichana (E 455 Stell. Mus.).
Tentaculites crotalinus (E 452 Stell. Mus.).
Dalmanites (Cr.) caffer (18 S.A. Mus.).
Homalonotus Herscheli (414, 415 Kimb. Mus.), (29 S.A. Mus.).
 „ „ var. *rectisuturalis* ? (29 S.A. Mus.).
 „ „ var. *Grahami* (2554 S.A. Mus.).
 „ „ var. *bituberculata* (368 S.A. Mus.).
 „ *fontinalis* (Sedgw. Mus.).
 „ *quernus* ? (23 S.A. Mus.).

GYDO PASS, CERES.

- Orthis satellites* (6721 S.A. Mus.).
Stropheodonta cf. *Katzeri* (128 S.A. Mus.).
Schuchertella Sulivani (5441, 5433, 5435, 5440 S.A. Mus.).
Chonetes cf. *Hallei* (6694 S.A. Mus.).
 „ *falklandicus* ? (5426 S.A. Mus.).

Cryptonella Baini (135 S.A. Mus.).

Leptocoelia flabellites (11353 Brit. Mus.), (115, 116, 137, 153, 210, 5439 S.A. Mus.), (405 Kimb. Mus.), (506, 509 Pret. Mus.), (2587 Alb. Mus.).

Ambocoelia pseudo-umbonata (137 S.A. Mus.), (319 Univ. Cape), (128 Kimb. Mus.), (457 Pret. Mus.), (2591, 2594 Alb. Mus.).

Spirifer antarcticus var. *kayseriana* (401 Pret. Mus.).

„ *ceres* (S.A. Mus.).

Rensselaeria montaguensis (30 S.A. Mus.), (405 Kimb. Mus.).

Trigeria gydoensis (156 S.A. Mus.).

Derbyina simplex (2589 Alb. Mus.).

„ *hottentot* ? (153, 166 S.A. Mus.).

„ *whitiorum* var. *africana* (B 45500 Brit. Mus.).

Palaeoneilo arcuata (3960 S.A. Mus.), (Sedgw. Mus.).

„ *rudis* (S.A. Mus.).

Nuculites abbreviatus (11339 Brit. Mus.), (5432, 5423 S.A. Mus.), (411 Kimb. Mus.), (109 Alb. Mus.).

„ *africanus* (6702 S.A. Mus.), (11337, 11338 Brit. Mus.).

„ *obtus* (121, 119, 130 Alb. Mus.).

„ *oblongatus* (6696 S.A. Mus.).

„ *pacatus* (108 Alb. Mus.).

„ *colonicus* (118 Alb. Mus.).

Ctenodonta Stowi (11353 Brit. Mus.).

Goniophora gydoensis (5436 S.A. Mus.).

Grammysia scaphuloides ? (77 Univ. Cape).

Janeia Baini (91 S.A. Mus.).

Actinopteria Eschwegii (14 S.A. Mus.).

Diaphorostoma Baini (106 Alb. Mus.), (11346, 11347 Brit. Mus.).

Palaeoscurria Sharpei (45501, 11332 Brit. Mus.).

Loxonema capense (164, 163 S.A. Mus.), (2543 Alb. Mus.).

Bellerophon cf. *Dereimsi* (213 S.A. Mus.).

Hyalithes subaequalis (8 S.A. Mus.).

Tentaculites Baini (181 S.A. Mus.).

Conularia quichua ? (72 S.A. Mus.).

Dalmanites (Anch.) *africanus* (33, 23 Alb. Mus.), (6695 S.A. Mus.), (11295 Brit. Mus.), (11287, 11296 ? Brit. Mus.).

„ (Cr.) *caffer* (2558 Alb. Mus.).

„ ? *ceres* (27 Alb. Mus.).

Phacops (Calm.) *impressus* (24 Alb. Mus.), (11291 Brit. Mus.).

„ „ *ocellus* (11284 Brit. Mus.).

- Phacops* (*Calm.*) *Lakei* (11289 Brit. Mus.).
 „ (*Penn.*) *gydowi* (28, 26, 25 Alb. Mus.).
Typhloniscus Baini (37 S.A. Mus.), (11302 Brit. Mus.).
Homalonotus Herscheli (413 Kimb. Mus.), (45080 Brit. Mus.).
 „ „ var. *perarmata* (11279 Brit. Mus.).
 „ „ var. *rectisuturalis* (45075 Brit. Mus.).
 „ *quernus* ? (11280 Brit. Mus.).
 „ *noticus* var. *africana* ? (11283 Brit. Mus.).

RIET VALLEI, E.N.E. OF CERES.

- Grammysia* (*Grammysioidea*) *scaphuloides* (192 S.A. Mus.).

WARM BOKKEVELD, CERES.

- Crinoid stem-joints (Brit. Mus.).
Stropheodonta arcei (B 45502 Brit. Mus.), (11357 Brit. Mus.).
Stropheodonta concinna ? (131 S.A. Mus.).
Schuchertella Sulivani (11330 Brit. Mus.), (11331 Brit. Mus.), (89, 92, Alb. Mus.).
 „ ? *Baini* (11325 Brit. Mus.).
Chonetes falklandicus (11324 Brit. Mus.), (11326 Brit. Mus.).
 „ *Hallei* (B 45502 Brit. Mus.).
Leptocoelia flabellites (89, 92 Alb. Mus.), (11325 Brit. Mus.).
Cryptonella Baini (11324 Brit. Mus.).
Spirifer antarcticus (119 S.A. Mus.), (11324 Brit. Mus.).
 „ „ var. *kayseriana* (11313 Brit. Mus.), (11318 Brit. Mus.), (11327 Brit. Mus.).
 „ *ceres* (49 Alb. Mus.).
Rensselaeria relictæ (93 Alb. Mus.).
Retzia ? *Thomasi* (? 131 S.A. Mus.).
Vitulina pustulosa ? (131 S.A. Mus.).
Nuculites obtusus (1485 Alb. Mus.).
Ctenodonta Grahami (81 Alb. Mus.).
Hyalithes subaequalis (11351 Brit. Mus.).
Serpulites sica (Brit. Mus.).
Bellerophon (*Plect.*) cf. *laticarinatus* (124, 126, 129 Alb. Mus.).
 „ „ *quadrilobatus* (11351 Brit. Mus.).
 „ „ *fraternus* (128 Alb. Mus.).
 „ (*Trop.*) cf. *globosus* (Alb. Mus.).
Tentaculites crotalinus (11351 Brit. Mus.).
Homalonotus sp. (11278 Brit. Mus.).

CERES.

Homalonotus quernus ? (3292 Kimb. Mus.).

LEO HOEK (?=LEEUFONTEIN, WARM BOKKEVELD, CERES).

Monotrypa ? sp. (11358 Brit. Mus.).

Nuculites ? *ovatus* (11342 Brit. Mus.).

Palaeoneilo antiqua (11336 Brit. Mus.), (14849 Brit. Mus.), (52056 Brit. Mus.).

„ *sancti-crucis* ? (I. 14848 Brit. Mus.).

Modiomorpha lunulata (135 Alb. Mus.).

Grammysia corrugata (11343, 14850 Brit. Mus.).

Toechomya ? *rudis* (11345 Brit. Mus.).

Janeia Baini (11344 Brit. Mus.).

Dalmanites (Anch.) *africanus* (11295 Brit. Mus.).

„ (Cr.) *caffer* (11290 Brit. Mus.).

Homalonotus Herscheli (11276, 11294, 11282, 52053 Brit. Mus.).

„ „ var. (11277 Brit. Mus.).

STETTYN, NEAR WORCESTER.

Acidaspis capensis (116 Cape Univ.).

Typhloniscus Baini (117, 120 Cape Univ.).

N.W. OF LADY GREY, NEAR WORCESTER.

Spirifer Ceres ? (143 S.A. Mus.).

WOLSELEY.

Homalonotus Herscheli (In. 22315, 22316 Brit. Mus.).

GAMKA POORT.

Orbiculoidea Baini (159 S.A. Mus.).

Leptocoelia flabellites (146, 221, 12 S.A. Mus.), (403 Pret. Mus.),
(Sedgw. Mus.).

Spirifer antarcticus var. *gamkaensis* (146 S.A. Mus.), (109 S.A. Mus.).

„ „ vars. S.A. Mus.

*Rensselaeria relict*a (Sedgw. Mus.), (221 S.A. Mus.).

Derbyina variegata (456 Pret. Mus.).

Goniophora ? sp. (146 S.A. Mus.).

Nuculites obtusus (92, 97 S.A. Mus.).

„ *capensis* (93 S.A. Mus.).

Ctenodonta Stowi (95, 96 S.A. Mus.).

- Bellerophon* (*Plect.*) *quadrilobatus* (27 S.A. Mus.).
 „ *cf. laticarinatus* (S.A. Mus.).
 „ *cf. morganianus* (110 S.A. Mus.).
Conularia gamkaensis (75 S.A. Mus.), (2607 Alb. Mus.).
Diaphorostoma ? sp. (161, 162, 163 S.A. Mus.).
Orthoceras bokkeveldense (172, 173 S.A. Mus.), (Alb. Mus., 2564-7).
 „ *gamkaense* (177, 178 S.A. Mus.).
Phacops (*Calm.*) *impressus* (43, 50, 44 S.A. Mus.), (Sedgw. Mus.), (2557, 2556 Alb. Mus.).
 „ „ „ var. nov. *vicina* (418 Kimb. Mus.).
 „ „ *ocellus* (42, 58 S.A. Mus.).
Dalmanites (*Anch.*) *africanus* (67, 27, 68 S.A. Mus.).
 „ „ *arbutus* (62, 64 S.A. Mus.).
 „ „ *Baini* ? (222 S.A. Mus.).
 „ (*Hausm.*) *lunatus* (66 S.A. Mus.).
 „ „ *Dunni* (38, 3949 S.A. Mus.).
Phacops (*Calm.* ?) *pupillus* (59 S.A. Mus.).
Typhloniscus Baini (71 S.A. Mus.), (63, 41, 46 S.A. Mus.).
Homalonotus Herscheli var. *fusiformis* (21 S.A. Mus.).
Proetus malacus (45 S.A. Mus.), (Sedgw. Mus.).

ROAD BETWEEN MONTAGU AND TRIANGLE.

- Modiomorpha montaguensis* (Stell. Mus.).
 „ *nigra* (625 S.A. Mus.), (Stell. Mus.).
 „ (*Modiella* ?) sp. (Stell. Mus.).

ROODE HOOGBE KLOOF, BETWEEN MONTAGU AND TRIANGLE.

- Loxonema cf. gregarium* (5421 S.A. Mus.).

MONTAGU.

- Ophiocrinus Stangeri* (169 Pret. Mus.).
Derbyina sp. (2127 Alb. Mus.).
Rensselaeria montaguensis (1610, 1612 S.A. Mus.).
Spirifer antarcticus (12a S.A. Mus.), (134, 2128 Alb. Mus.), (1889 Alb. Mus.).
 „ „ var. *kayseriana* (134 Alb. Mus.).
 ? *Orthoceras bokkeveldense* (81 Cape Univ.).

NORTH OF MONTAGU.

- Spirifer antarcticus* var. *kayseriana* (147 S.A. Mus.).
Leptocoelia flabellites (147 S.A. Mus.), (134, 2128 Alb. Mus.).

UITOLUGT, MONTAGU.

Lingula lepta (5415 S.A. Mus.), (169a S.A. Mus.).

STINKFONTEIN, NEAR TRIANGLE.

Spirifer antarcticus (154 S.A. Mus.), (north of Stinkfontein).

Leptocoelia flabellites (154 S.A. Mus.).

Centronella cf. *derbyana* (424 Pret. Mus.).

Rensselaeria rotunda (449 Pret. Mus.).

Palaeoneilo rudis (100 S.A. Mus.).

TWO HUNDRED YARDS FROM TRIANGLE STATION.

Orthis satelles (138a, 7203, 15 S.A. Mus.).

Dalm. (Cr.) caffer (138a S.A. Mus.).

S.E. OF TRIANGLE BELOW SECOND SANDSTONE.

Spirifer Ceres (144, 149 S.A. Mus.).

Ctenodonta Stowi (133a, 7777 S.A. Mus.).

THIRD SANDSTONE, TUNNEL SIDING.

Lingula lepta (123 S.A. Mus.), (124 Sedgw. Mus.).

SHALES ABOVE THIRD SANDSTONE, TUNNEL SIDING.

Sphenotus aff. *Gorceixi* (101 S.A. Mus.).

THREE MILES S.E. OF TRIANGLE.

Spirifer antarcticus (160 S.A. Mus.).

OSPLAATS, DE DOORNS.

Orbiculoidea Baini (E 915 Stell. Mus.).

Spirifer antarcticus (E 3), (E 417 Stell. Mus.).

Janeia braziliensis (Stell. Mus.).

Dalmanites (Cr.) caffer (E 414, E 483 Stell. Mus.).

Phacops (Penn.) africanoides (E 416 Stell. Mus.).

Homalonotus Herscheli (E 415 Stell. Mus.).

„ „ var. *perarmata* (E 416 Stell. Mus.).

BUFFELSKRAAL, DE DOORNS.

Dalmanites (Cr.) caffer (H 173 Stell. Mus.).

„ (*Cor.*) *capensis* (H 172 Stell. Mus.).

BLACK'S FARM, DE DOORNS.

Meristella cf. *Riskowski* (H 64 Stell. Mus.).

DE DOORNS.

Ophiocrinus Stangeri (Sedgw. Mus.).

Chonetes Stübeli (Sedgw. Mus.).

Spirifer antarcticus var. *kayseriana* (1160 S.A. Mus.).

„ *Ceres* var. *Iheringi* (Sedgw. Mus.).

Leptocoelia flabellites (Sedgw. Mus.).

Palaeoneilo vindicata (Sedgw. Mus.).

Ctenodonta Stowi (Sedgw. Mus.).

Nuculites Sharpei (Sedgw. Mus.).

„ *pacatus* (Sedgw. Mus.).

Nuculana inornata (Sedgw. Mus.).

Dalmanites (Cr.) *caffer* (2463 S.A. Mus.).

Phacops (Calm.) *ocellus* ? (Sedgw. Mus.).

Homalonotus fontinalis (Sedgw. Mus.).

Proetus hexensis (H 176 Stell. Mus.).

Tentaculites crotalinus (Sedgw. Mus.).

KEURBOSCH, HEX RIVER DISTRICT.

Orbiculoidea ? *aberrans* (289 Cape Univ.).

Palaeoneilo Orbignyi var. *tenuilineata* (128 Cape Univ.).

Nuculites Sharpei var. *remota* (129 Cape Univ.).

Modiomorpha hexensis (280 Cape Univ.).

Sphenotomorpha cf. *Bodenbenderi* (303 Cape Univ.).

Tentaculites desuetus (135 Cape Univ.), (293, 291 Cape Univ.).

Homalonotus sp. (264a, 297 Cape Univ.).

FIRST SANDSTONE, EAST OF KLEIN STRAAT SIDING.

Spirifer ceres var. *Iheringi* (1087, 1095, 1096, 1097 S.A. Mus.).

Nuculites abbreviatus (111 S.A. Mus.).

Janeia braziliensis (111 S.A. Mus.).

KLEIN STRAAT STATION.

Dalmanites (Cor.) *capensis* (H 76 Stell. Mus.).

Janeia braziliensis (441 Pret. Mus.).

KAMANASSIE RIVER, OUDTSHOORN.

Janeia braziliensis (5419 S.A. Mus.).

NOOITGEDACHT, OUDTSHOORN DISTRICT.

Loxonema capense (S.A. Mus.).

PAARDE BOUT, OUDTSHOORN DISTRICT.

Loxonema capense (3287 Kimb. Mus.).

UITGIFT, CALEDON.

Leptocoelia flabellites (2588 Alb. Mus.).

COCKSCOMB MOUNTAINS.

Zaphrentis Zebra (1586 Alb. Mus.).

,, sp.

Leptocoelia flabellites (1588, 1589 Alb. Mus.).*Proetus malacus* (Bl. Mus.) (35 Alb. Mus.).*Dalmanites* (Anch.) *crisagalli* (Brit. Mus.), (5 Alb. Mus.).,, ,, *africanus* (Bl. Mus.).,, (Cr.) *caffer* (Bl. Mus.).*Phacops* (Penn.) *gydowi* (Bl. Mus.).

ASSEGAI BOSCH, ROODE BERG, LADISMITH.

Rensselaeria relicta ? (149 S.A. Mus.).

GEELBOSCHLAAGTE, LADISMITH.

Orbiculoidea Baini (436 Pret. Mus.).*Leptocoelia flabellites* (434, 436 Pret. Mus.), (S.A. Mus.).*Derbyina whitiorum* var. *africana* (435, 436 Pret. Mus.).*Cryptonella Baini* (511 Pret. Mus.), (Sedgw. Mus.).

PAPENKUILS FONTEIN, PRINS RIVER, NEAR LADISMITH.

Stropheodonta Arcei (94, 97 Cape Univ.).

UNIONDALE.

Rensselaeria montaguensis (606 S.A. Mus.).

PRINCE ALBERT.

Buchiola subpalmata (593 Kimb. Mus.).*Conularia africana* var. *albertensis* (2017 Kimb. Mus.).

WOLVEREDEN, PRINCE ALBERT.

Dalmanites (*Anchiopella*) *africanus* (5420 S.A. Mus.).

BOSCHLUIJS KLOOF, PRINCE ALBERT.

- Chonetes* sp. (2582 Alb. Mus.), (496, 500, 487, 112, 118 S.A. Mus.).
Leptocoelia flabellites (2585 Alb. Mus.), (433 Pret. Mus.), (5a, 8a, 495 S.A. Mus.).
Spirifer antarcticus var. *kayseriana* (422 Pret. Mus.).
Derbyina whitiorum var. *africana* (427 Pret. Mus.).
 „ *simplex* (8a S.A. Mus.).
Dalmanites (*Anchiop.*) *Baini* (433 S.A. Mus.).
Phacops (*Penn.*) *gydowi* (1167 S.A. Mus.).

ZWARTBERG PASS.

- Orbiculoidea Baini* (158 S.A. Mus.).
Palaeoneilo antiqua (S.A. Mus.).
 „ *subantiqua* ? (S.A. Mus.).
Nuculites abbreviatus (1599 S.A. Mus.), (1618, 1616, 1615 S.A. Mus.).
 „ *africanus* (1619, 1620 S.A. Mus.).
 „ cf. *Beneckeii* (1622 S.A. Mus.), (1181 S.A. Mus.), (Sedgw. Mus.).
 „ *oblongatus* (1623 S.A. Mus.).
 „ *obtusius* (1625, 1624, 622 S.A. Mus.), (Sedgw. Mus.).
 „ *pacatus* (794 S.A. Mus.), (1626, 1627 S.A. Mus.), (1161a S.A. Mus.).
Ctenodonta ? *nigella* (3946 S.A. Mus.).
Nuculana viator (S.A. Mus.).
 „ *agrestis* (S.A. Mus.).
Grammysia corrugata (S.A. Mus.).
 „ *montana* (1805 S.A. Mus.).
Janeia bokkeveldensis (1607 S.A. Mus.).
 „ „ var. *acer* (625c S.A. Mus.).
Buchiola subpalmata (Sedgw. Mus.).
Cardiola sp. (Sedgw. Mus.).
Metoptoma capense (1178, 1179 S.A. Mus.).
Loxonema zwartbergense (624 S.A. Mus.).
Hyalolithes d'Orbigny var. nov. *capensis* (2018 Kimb. Mus.).

KOUDEVELD BERG, BELOW FIRST SANDSTONE.

- Janeia braziliensis* (S.A. Mus.).
Actinopteria Eschwegii (81 S.A. Mus.).
Conularia sp. (80 S.A. Mus.).
Typhloniscus Baini (458 S.A. Mus.).

Platyceras bokkeveldense (2442 S.A. Mus.).

Homalonotus noticus var. *africana* (438 and 431 Pret. Mus.).

GOURITZ RIVER.

Rensselaeria rotunda (605 S.A. Mus.).

Scaphiocoelia africana (607, 609, 1173 S.A. Mus.).

STEYTLERVILLE DISTRICT.

Derbyina simplex var. (105 Port. Eliz. Mus.).

BOKKE RIVIER, 17 MILES FROM TOUWS RIVER, ON ROAD
TO CERES.

Homalonotus Herscheli var. *rectisuturalis* (314 Cape Univ.).

„ „ var. *colossus* (309, 310, and 317 Cape Univ.).

LANGEFONTEIN.

Spirifer Ceres (Sedgw. Mus.).

„ „ var. *Iheringi* (Sedgw. Mus.).

COLD BOKKEVELD.

Leptocoelia flabellites (11319, 11320 Brit. Mus., etc.), (48, 42 Alb. Mus.).

Homalonotus Herscheli var. *perarmata* (7194 S.A. Mus.).

„ „ var. *rectisuturalis* (7193 S.A. Mus.).

WINTERHOEK MOUNTAINS.

Dalmanites (Cr.) *caffer* var. *albana* (69 Alb. Mus.).

Phacops (*Phacopina*) *hiemalis* (In. 24100 Brit. Mus.).

DRIEFONTEIN, CLANWILLIAM.

Orbiculoidea cf. *collis* (6716 S.A. Mus.).

HOENDERFONTEIN, CLANWILLIAM.

Orbiculoidea Baini (2606 Alb. Mus.).

Diaphorostoma Baini (454 Pret. Mus.).

Dalmanites (Ac.) *pseudoconvexus* (7201 S.A. Mus.), (419 Kimb. Mus.).

„ (*Anch.*) *africanus* (453 Pret. Mus.).

„ (*Cr.*) *caffer* (2559, 2555, 74 Alb. Mus.).

Homalonotus Herscheli var. *bituberculata* (B 4 S.A. Mus.).

WHUPPERTHAL, CLANWILLIAM.

Orbiculoidea Baini (158 S.A. Mus.), (North of Wh.).

Bellerophon (*Plect.*) *fraternus* (1180 S.A. Mus.).

„ „ *cf. laticarinatus* (107 S.A. Mus.), (road cutting north of Wh.).

„ „ *aff. Reissi* (108 S.A. Mus.), (road cutting north of Wh.).

Homalonotus Herscheli var. *perarmata* (7192 S.A. Mus.).

Conularia africana (73, 74 S.A. Mus.).

CEDARBERG, CLANWILLIAM.

Orbiculoidea Baini (11335 Brit. Mus.).

Nuculites africanus ? (11338 Brit. Mus.).

„ *obtus* (130 Alb. Mus.).

„ *Sharpei* (131 Alb. Mus.).

Conularia africana (11348 Brit. Mus.).

„ *Baini* (116, 117 Alb. Mus.).

„ *ulrichana* (11349 Brit. Mus.).

Dalmanites (*Anch.*) *africanus* (I. 4047 Brit. Mus.).

Phacops (*Calm.*) *callitris* (29-34 Alb. Mus.), (In. 4955 Brit. Mus.).

„ „ *ocellus* (14956, 14957 Brit. Mus.).

Homalonotus Herscheli (*lex*) (1, 13, 9 Alb. Mus.).

? „ „ var. *perarmata* (1444 Alb. Mus.).

KEURBOOM'S RIVER, PLETTENBERG BAY.

Crinoid stems (Durb. Mus.).

Leptocoelia flabellites (Durb. Mus.).

Spirifer antarcticus var. *kayseriana* (I. 858 Brit. Mus.).

Nuculites africanus (795 S.A. Mus.), (1830 Brit. Mus.).

Loxonema zwartbergense (G. 1711 Brit. Mus.).

Orthoceras (*Spyr.* ?) *rex* (2812 Alb. Mus.).

Dalmanites (*Anch.*) *africanus* (I. 857 Brit. Mus.).

Phacops (*Bouleia* ?) *Sharpei* (I. 858 Brit. Mus.).

„ sp. (70 S.A. Mus.).

Acidaspis Atherstonei (24103, 24104 Brit. Mus.).

ROZENDAL.

Homalonotus sp. (48774 Brit. Mus.).

Dalmanites (*Anchiopella*) *cf. africanus* (48774 Brit. Mus.)

RIET KUIL, UITENHAGE.

Scaphiocoelia africana var. *elizabethae* (1173a, 1175, 1176 S.A. Mus.).

CONCLUSIONS.

The present author, in 1907,* drew the following conclusions from the evidence then available of the organic contents of the Bokkeveld Beds: (1) "The Bokkeveld fauna is more closely allied to that of the Devonian of South America than to that of any other area." All the recent evidence brought forward in this paper considerably strengthens this conclusion.

(2) "This southern Devonian fauna is marked by the special development of certain peculiar subgenera (*Anchiopella* and *Metacryphaeus* †), and by the predominance of other genera or groups (e.g. *Palaeoneilo*, *Nuculites*, ribbed centronellids, Bellerophonitids of the *trilobatus* group), as well as by the absence or extreme rarity of many others, and of certain groups (cephalopods, corals, bryozoans)." To this list we may add the peculiar Brazilian phacopid, subgenus *Pennaia*, which Dr. Shand was the first to record in South Africa, although the earlier established species, *Ph. Gydowi* Schwarz, may now be assigned to it. Of peculiar genera of brachiopods we have now to add *Derbyina* and *Clarkeia*, while Kozłowski's new subgenera of *Phacops*, which he terms *Bouleia* and *Dereimsia*, and Clarke's *Phacopina* and *Proboloides*, are likewise also limited to the austral fauna, three of them being now recognised in the Bokkeveld fauna.

(3) "The affinities of this fauna are much closer to that of the Devonian of North America (eastern parts) than to the West European type."

Repeated allusions have been made in the foregoing descriptions of Bokkeveld species to their affinities with those of the Lower Devonian of Quebec and Maine; but with comparative rarity has any close alliance been observable to European forms. The special attention which the author has lately paid to the Lower Devonian of south-western England, and of the Rhenish area, convinces him of the accuracy of this conclusion. We cannot, however, still maintain that the Bokkeveld fauna is rather of a Middle than Lower Devonian type when compared with North American faunas, for the evidence on which this conclusion was based is found to be only slightly supported by the study of the greatly-increased series of Bokkeveld fossils and the much better preserved material. It must also be

* Reed, Geol. Mag., Dec. v, vol. iv, 1907, pp. 230, 231.

† Clarke (*op. cit.*, 1913, pp. 72, 79) was mistaken in believing that my *Metacryphaeus* was intended to include *Acaste convexa* Ulrich, *A. acutilobata* Knod, etc., and that his *Dalmanites australis* belonged to my *Anchiopella*.

emphasised that, although the affinities of many of the species are with Lower rather than Middle Devonian forms in Europe, there are no identical species, and a recognisable European element is conspicuous by its absence. The close relations between the South African and South American Devonian faunas and the common austral facies which they possess are demonstrated by the results embodied in this memoir, and the view that the South African assemblage is more closely linked to the European than is the South American must be abandoned.

The conclusion, however, which the author reached in 1907 that "the Bokkeveld fauna has a certain individuality of its own owing to the presence of certain peculiar genera (e.g. *Typhloniscus*) and species, in spite of its close relations to that of the South American Devonian," is fully justified. As Clarke (*op. cit.*, 1913, pp. 17-20, 68, 69) has pointed out, isolation has led to the development of local differences, though the degree of segregation and the persistence, position, and nature of the barriers between the various areas of the austral province are by no means certain. There is, however, a marked unity of character in spite of regional differentiation, and it is noteworthy that with increased knowledge of the fossil contents of the beds the distinctions and differences have grown less.

The presence of several elements in the Bokkeveld fauna may be more apparent than real, and the stratigraphical distribution of the species is still most imperfectly ascertained. But, as stated by the author in 1907, we may recognise a characteristic South African element and a strong South American element, as well as certain less-marked North American, and still more faintly-marked European elements, the latter being almost negligible.

Finally, the opinion may be again expressed that the fauna of the Bokkeveld series has a general homogeneity, and that the occasional local restriction of species appears to result chiefly from differences of environment and conditions of sedimentation or preservation, or even from the vagaries of collecting, and their distribution cannot, at any rate at present, be employed for the recognition of definite stratigraphical horizons, though it is probable that with increased knowledge of the vertical range of members of the fauna we shall be able to distinguish a certain zonal succession.

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EXPLANATION OF PLATES.

PLATE IV.

FIG.

1. *Placocystis africanus* sp. nov. $\times 2\frac{1}{2}$. Dorsal surface. Roadside cutting near Buffelskraal, De Doorns. (Sedgwick Museum, Cambridge.)
2. *Codaster* aff. *pyramidatus*, Shumard. Nat. size. Radial plate. Same locality. (Sedgw. Mus., Camb.)
3. *Lingula scalprum* Clarke. $\times 1\frac{1}{2}$. Hottentot's Kloof, Ceres. (H 67 Stellenbosch Museum.)
4. *Orbiculoidea* ? *aberrans* sp. nov. Nat. size. Brachial valve. Keurbosch, Hex River district. (289a Cape Univ. Coll.)
- 4a. Do. Portion of surface of same specimen. $\times 8$.
5. *Orthis* (*Dalmanella*) *satelles* sp. nov. $\times 2$. 200 yards from Triangle Station, Hex River Pass. (7203 S.A. Mus.)
6. *Rhynchonella* (*Clarkeia*) *Bodenbenderi* (Kayser). $\times 1\frac{1}{2}$. Internal cast of brachial valve. Ezelfontein, Ceres. (Sedgw. Mus., Camb.)
7. *Chonetes Rücki*, Ulrich, var. nov. *medialis*. $\times 2$. Impression of exterior of pedicle-valve. Touws River Road, Upper Hex River Valley. (207 Cape Univ. Coll.)
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PLATE V.

1. *Spirifer euelpis* sp. nov. $\times 1\frac{1}{2}$. Pedicle-valve. Uitkomst, Ceres. (3821 S.A. Mus.)
2. *Derbyina whitiorum* Clarke, var. nov. *africana*. $\times 1\frac{1}{2}$. Internal cast of brachial valve. Gydo Pass. (B 45500 Brit. Mus.)
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FIG.

5. *Meristella* cf. *Riskowskii*, Ulrich. Nat. size. Internal cast of pedicle-valve. Black's Farm, De Doorns. (H 64 Stellenbosch Mus.)
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7. *Nuculites Sharpei* Reed, var. nov. *remota*. Nat. size. Internal cast. Locality unknown. (796 S.A. Mus.)
8. *Ctenodonta Stowi* sp. nov. $\times 1\frac{1}{2}$. Right valve. 300 yards from Triangle Station. (7777 S.A. Mus.)
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12. *Modiomorpha (Modiella?)* sp. Nat. size. Right valve. Road between Montagu and Triangle. (Stellenbosch Mus.)
13. *Janeia braziliensis* Clarke. Nat. size. Left valve of complete shell. Kama-nassie River, Oudtshoorn. (5419 S.A. Mus.)
- 13a. Do. Nat. size. Right valve of same specimen.
14. *Modiomorpha montaguensis* sp. nov. Nat. size. Right valve. Road between Montagu and Triangle. (Stellenbosch Mus.)

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1. *Modiomorpha hexensis* sp. nov. Nat. size. Right valve. Roadside cutting near Buffelskraal, De Doorns. (Sedgw. Mus., Camb.)
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4. *Grammysia (Grammysioidea) scaphuloides* sp. nov. Nat. size. Right valve (crushed). Riet Vallei near Ceres. (192 S.A. Mus.)
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8. Do. $\times 1\frac{1}{2}$. Young individual, right valve. Laken Vlei, Ceres. (3791 S.A. Mus.)
9. *Myalina brevicardinalis* sp. nov. $\times \frac{3}{4}$. Right valve. Locality unknown. (7202 S.A. Mus.)
10. *Sphenotomorpha Bodenbenderi* (Clarke), var. nov. *capensis*. Nat. size. Right valve. Bokkeveld. (2019 Kimb. Mus.)
11. *Palaeoneilo vindicata* sp. nov. Nat. size. Right valve. De Doorns. (Sedgw. Mus., Camb.)
12. Do. Nat. size. Left valve. Same locality. (Sedgw. Mus., Camb.)
13. *Cardiola?* sp. $\times 4$. Internal cast of complete shell. Zwartberg Pass. (Sedgw. Mus., Camb.)

PLATE VII.

FIG.

1. *Platyceras bokkeveldense* sp. nov. Nat. size. Koudeveld Berg. (2442 S.A. Mus.)
2. *Hyolithes D'Orbigny* Kozl., var. nov. *capensis*. Nat. size. Ventral face. Zwartberg Pass. (2018 Kimb. Mus.)
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- 2c. Do. Portion of surface of same specimen. $\times 10$.
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- 3b. Do. Portion of surface of same specimen. $\times 2\frac{1}{2}$.
4. *Loxonema zwartbergense* sp. nov. Nat. size. Internal cast. Zwartberg Pass. (624 S.A. Mus.)
- 4a. Do. Impression of exterior of same specimen.
5. *Palaeoscurria Sharpei* sp. nov. Nat. size. Gydo Pass. (B. 45501 Brit. Mus.)
- 5a. Do. Side view of same specimen.
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6. *Bellerophon (Patellostium) africanoides* sp. nov. Nat. size. Dorsal view. Locality unknown. (14 Cape Univ. Coll.)
- 6a. Do. Side view of same specimen.
- 6b. Do. Ventral view of same specimen.
7. *Acidaspis Atherstonei* sp. nov. $\times 1\frac{1}{2}$. Part of thorax and pygidium. Keurboom's River, Plettenberg Bay. (In. 24103 Brit. Mus.)
- 7a. Do. $\times 3$. Distal portions of several pleurae of same specimen.
- 7b. Do. $\times 1\frac{1}{2}$. Impression of some thoracic segments of same specimen.
8. *Proetus hexensis* sp. nov. $\times 1\frac{1}{2}$. Pygidium. De Doorns. (H 176 Stellenbosch Mus.)
9. *Tentaculites desuetus* sp. nov. Nat. size. Keurbosch. (135 Cape Univ. Coll.)
10. Do. Nat. size. Locality unknown. (7776 S.A. Mus.)

PLATE VIII.

1. *Dalmanites (Anchiopella) africanus* (Salter) sens. restr. Nat. size. Internal cast of complete individual. Cedarberg. (I 4047 Brit. Mus.)
- 1a. Do. Side view of same specimen.
- 1b. Do. Anterior view of same specimen.
- 1c. Do. Dorsal view of part of thorax of same specimen.
2. *Dalmanites (Cryphaeus?)* cf. *rostratus* Kozlowski. $\times 1\frac{1}{2}$. Anterior view of margin of head-shield. Roadside cutting near Buffelskraal, De Doorns. (Sedgw. Mus., Camb.)
3. *Dalmanites (Cryphaeus)* cf. *Pentlandi*, Salter. $\times 1\frac{1}{2}$. Imperfect pygidium. Tunnel siding near Triangle. (447 Pretoria Mus.)
4. *Dalmanites (Proboloides) ensifer* sp. nov. Nat. size. Head-shield. Locality unknown. (C 2 Stellenbosch Mus.)
- 4a. Do. Front view of same specimen.
- 4b. Do. Side view of same specimen.
- 4c. Do. Inferior surface of same specimen.
- 4d. Do. $\times 3$. Eye of same specimen.

FIG.

5. *Dalmanites* (*Corycephalus*?) *capensis* sp. nov. Nat. size. Head-shield and part of thorax. Klein Straat Station. (H 76 Stellenbosch Mus.)
6. Do. Another head-shield. Nat. size. Buffelskraal, De Doorns. (H 172 Stellenbosch Mus.)

PLATE IX.

1. *Dalmanites* (*Anchiopella*) *Baini* sp. nov. $\times 1\frac{1}{2}$. Head-shield. Locality unknown. (Sedgw. Mus., Camb.)
2. Do. Nat. size. Group of head-shields. Locality unknown. (7200 S.A. Mus.)
3. Do. Nat. size. Head-shield. Locality unknown. (139 Cape Univ. Coll.)
4. *Phacops* (*Calmonia*) *Lakei* sp. nov. $\times 1\frac{1}{2}$. Head-shield. Touws River Road. (232 Cape Univ. Coll.)
5. Do. $\times 2\frac{1}{2}$. Small complete individual. Same locality. (138 Cape Univ. Coll.)
6. *Phacops* (*Bouleia*?) *Sharpei* sp. nov. $\times 1\frac{1}{2}$. Pygidium. Same locality. (198 Cape Univ. Coll.)
7. *Phacops* (*Pennaia*) *Gydowi* Schwarz. Nat. size. Complete individual. Boschluis Kloof, Prince Albert. (1167 S.A. Mus.)
- 7a. Do. $\times 2$. Pygidium of same specimen.
8. *Dalmanites* (*Acastella*?) *pseudoconvexus* sp. nov. $\times 1\frac{1}{2}$. Head-shield. Hoenderfontein, Clanwilliam. (419 Kimb. Mus.)
9. Do. ? Nat. size. Imperfect pygidium. Same locality. (7201 S.A. Mus.)
10. *Dalmanites* (*Cryphaeus*) *caffer* Salt. (emend.). $\times 1\frac{1}{2}$. Head-shield. Touws River Road. (175 Cape Univ. Coll.)
11. Do. Nat. size. Front view of another head-shield. Same locality. (179 Cape Univ. Coll.)
12. *Phacops* (*Phacopina*) *hiemalis* sp. nov. ? Nat. size. Pygidium possibly referable to this species. Same locality. (243 Cape Univ. Coll.)
13. *Homalonotus* (*Burmeisteria*) *quernus* Lake ? $\times \frac{1}{2}$. Thoracic segments, probably belonging to this species. Ceres. (3292 Kimb. Mus.)

PLATE X.

1. *Homalonotus* (*Burmeisteria*) *quernus* Lake. Nat. size. Head-shield. Locality unknown. (In. 24101 Brit. Mus.)
2. *Homalonotus* (*Burmeisteria*) *Herscheli* (Murch.) var. nov. *bituberculata*. Nat. size. Head-shield. Locality unknown. (I 254 Brit. Mus.)
3. *Homalonotus* (*Burmeisteria*) *Herscheli* (Murch.) var. nov. *rectisuturalis*. Nat. size. Head-shield. Locality unknown. (C 6 Stellenbosch Mus.)
4. *Homalonotus* (*Digonus*) *noticus* Clarke, var. nov. *africana*. $\times 1\frac{1}{2}$. Head-shield. Touws River Road. (247 Cape Univ. Coll.)
5. *Homalonotus* (*Burmeisteria*) *Herscheli* (Murch.) var. nov. *sodalis*. $\times \frac{1}{2}$. Head-shield. Locality unknown. (7199 S.A. Mus.)
6. *Homalonotus* (*Digonus*) *fontinalis* sp. nov. $\times 2\frac{1}{2}$. Nearly complete individual. Ezelfontein, Ceres. (Sedgw. Mus., Camb.)
7. *Homalonotus* (*Burmeisteria*) *Herscheli* (Murch.) var. nov. *rectisuturalis*. Nat. size. Head-shield. Cold Bokkeveld. (7193 S.A. Mus.)
8. *Phacops* (*Phacopina*) *hiemalis* sp. nov. Nat. size. Head-shield. (Type.) Winterhoek Mtns. (In. 24100 Brit. Mus.)

FIG.

9. *Phacops* (*Bouleia* ?) *Sharpei* sp. nov. $\times 2$. Pygidium. Keurbooms River, Plettenberg Bay. (I 858 Brit. Mus.)
10. *Cyphaspis* *Dereimsi* Kozl. $\times 2$. Nearly complete individual. Roadside cutting near Buffelskraal, De Doorns. (Sedgw. Mus., Camb.)

PLATE XI.

1. *Dalmanites* (*Cryphaeus*) *caffer* Salt. (emend.) var. nov. *albana*. $\times \frac{2}{3}$. Head-shield. Winterhoek. (69 Albany Mus.)
2. *Phacops* (*Pennaia*) *Gydowi* Schwarz. Nat. size. Head-shield. Cockscomb Mountains. (Bloemfontein Mus.)
3. *Proetus* *malacus* Lake. $\times 1\frac{1}{2}$ (approx.). Complete enrolled individual. Cockscomb Mountains. (Bloemfontein Mus.)
4. *Dalmanites* (*Cryphaeus*) *caffer* Salt. (emend.). Nat. size. Thorax and pygidium. Osplaats, Hex River Valley. (E 483 Stellenbosch Mus.)
5. *Dalmanites* (*Hausmannia*) *Dunni* sp. nov. $\times \frac{1}{2}$. Imperfect pygidium. Gamka Poort. (3949 S.A. Mus.)
6. *Acidaspis* *capensis* sp. nov. Nat. size. Thorax and pygidium. Stettyn, Worcester district. (116a Cape Univ. Coll.)
7. Do. Impression of same specimen. (116b Cape Univ. Coll.)
8. *Phacops* (*Calmonia*) *impressus* Lake, var. nov. *vicina*. $\times 1\frac{1}{4}$. Nearly complete individual. Gamka Poort. (418 Kimberley Mus.)
9. *Dalmanites* (*Cryphacus*) cf. *australis*, Clarke. $\times 1\frac{1}{4}$. Head-shield. Hottentot's Kloof, Ceres. (3850 S.A. Mus.)
10. *Dalmanites* (*Cryphaeus*) cf. *Pentlandi* Salter. Nat. size. Impression of thorax and pygidium. De Doorns. (2463 S.A. Mus.)

(Plates IX and XI are from photographs of the specimens.)